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THE INTIMATE RELATION BETWEEN OPHTHALMOLOGY AND NEUROLOGY

SOME REMINISCENCES

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When the chairman suggested this subject to me I was glad to seize this opportunity to call general attention once more to the very close relation between ophthalmology and neurology. When he added "some reminiscences" I was a little in doubt as to exactly what he had in mind. Probably I should reminisce by repeating some of the things I said thirty or forty years ago, or by calling up the distant past in order to prove that the relationship is no closer today, or no less close, than it was a half century ago, when I was a student of both subjects.

While I shall take special pains to refer to some of the facts proving the close relationship between ophthalmology and neurology, I am also eager to affirm this evening the intimate relation between ophthalmology and internal medicine. Altogether, it is of extreme importance, as I have intimated before, to prevent the present decentralization of medicine and to bring the various specialties into their proper and close affiliation with internal medicine and with surgery. There is no intention to lessen the value of special skill or the importance of special surgical skill. One will always be glad to fall back on the practicing ophthalmologist for the surgical care of conditions of the eye.

No one but the ophthalmologist will be asked to remove a cataract or to treat glaucoma, but the ophthalmologist will not be able to escape his responsibilities in the early detection of diseases of the kidneys or of the specific lesions of diabetes and of other diseases of the internal organs, which are so often associated with ocular changes.

Although I have been a specialist during practically my entire medical career, I am feeling more and more that I should like to have been a general medical clinician and a neurologist and psychiatrist to boot. Viewing the entire domain of medicine from the vantage point of long experience, and that is perhaps the only vantage point, I should like to encourage the ophthalmologist to insist that every medical student be graduated with a fair knowledge of the clinical signs and the importance of diseases of the eyes. I have always regarded it as one of the fortunate features of my undergraduate career that I was

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required to take a thorough course in ophthalmology. The knowledge of the eye that I gained at that time has stood me in good stead all these years, and I have remained so thoroughly devoted to ophthalmologic signs that I have always regarded an examination of the eye as part of every first routine examination.

This close relationship between various specialties must be maintained, and I take this opportunity to suggest that the Section on Ophthalmology decide on subjects which it considers as indicating the most recent thought in ophthalmologic circles and which, at the same time, are certain to be of interest and importance to the general medical public.

When not long ago I put the question to one of the well known members of this section as to the subject he would suggest for this purpose, he thought that optic neuritis was perhaps, at this time, the most important subject that would be of interest both to the ophthalmologist and to the general practitioner. Judging by my limited knowledge of the question, I think that most neurologists would like to hear what the views of competent ophthalmologists are regarding the diagnostic value of optic neuritis, or of choked disk, because while they have long since learned that optic neuritis or incipient choked disk, if I am correct in using the term, is always suggestive of an intracranial tumor, they have learned also, especially since the days of epidemic encephalitis and other forms of infectious encephalitis, that such changes in the backgrounds of the eyes are not always conclusive evidence of new growths within the skull.

If I may put the question, would it not be of importance also to study the arteriosclerotic changes in the eye much more thoroughly than has been the case, so far as my knowledge goes, in order to lead the way to the earliest detection of general arteriosclerotic diseases, especially early renal disturbance?

So far as choked disk is concerned, I have always had my doubts as to whether neurologists are inculcating the correct notions regarding decompression for this condition.[1] Safe as the operation seems to be,

1. "My own view is that the ordinary decompression operation, whether subtemporal or suboccipital, promises little for the relief of choked disk; in twenty-nine out of thirty-eight of our cases it was practically time and labor wasted. Instead of performing this operation, every effort shoud be made to attack the tumor itself and to remove the neoplasm, provided the patient's life can be spared. I suspect that in many instances, the decompression operation has discouraged the patient, has made a further operation objectionable, and has often lessened the ardor of the surgeon to get at the growth itself. If we are to go on with the decompression operation, for the relief of symptoms only, it must be made a harmless procedure; harmless as to life and harmless so far as the later successful removal of the brain tumor is concerned." Sachs, B.: Shall We Decompress for Choked Disk? (Quoted from Arch. Neurol. & Psychiat. **8**:515 [Nov.] 1922).

unnecessary operations are to be avoided. It would be important, therefore, to determine whether choked disk is always progressive, whether it is not to a certain extent self-limited, and whether one can tell in advance whether a relative amount of choked disk will lead to blindness.

I have said that it is important for the neurologist to get an insight into the fundamentals of ophthalmology. It is fully as important for the ophthalmologist to be thoroughly informed as to the bearing that these various changes in the fundi have on conditions that are much more serious than the ocular disturbances themselves. The condition of the pupils is much more important than the changes in the fundi with respect to the diagnosis of general and central nervous diseases.

Some one has said that the eyes are the windows of the soul. I should say that the pupils reveal the secrets of the body, and in this connection I am going to reveal one of my own pet, almost sacred beliefs. The reaction of the pupil may be a far more positive sign of constitutional syphilis than the Wassermann reaction itself, especially because the latter is so often negative when syphilis is present.

It is not merely the loss of reaction to light and of prompt contraction during accommodation which is significant of tabes dorsalis, but the sluggish reaction both to light and during accommodation in all forms of constitutional syphilis that is to my mind one of the most valuable symptoms that a patient can present to the examining physician. Where I find pupils mobile to light and sluggish during accommodation and where I find, in addition, an irregular contour of the pupil when the pupil responds or fails to respond to light, I shall risk the diagnosis of constitutional syphilis whether all possible reactions are corroborative of that diagnosis or not.

I have depended on that sign in practice for nearly fifty years. I do not think that it ever misled me. Of course, I was, I think, wise enough to recognize that in some instances peripheral conditions of the eye might be responsible and these, with my limited knowledge of the external eye, I may not have been wise enough to detect, but whenever I had any reasonable doubts, I had a competent ophthalmologist examine the eye.

To my surprise, I have found (and I trust that this statement will not be taken amiss) that the ophthalmologist does not seem to be as conscious of the tremendous diagnostic importance of the pupillary reaction as the neurologist is, I should be glad to learn that I am mistaken in this. Nor are the ophthalmologists as much interested in slight weaknesses of the ocular muscles as the neurologists are.

If I am to add anything by way of reminiscence, which I see was part of the title assigned to me, it is that I was one of those fortunate or unfortunate enough to pass through that painful era when a certain ophthalmologist—I don't know whether he was a regular member of

an ophthalmologic society or not—wrote article on article on the importance of keeping the ocular muscles exactly in trim, or at least in a condition in which there would be no excuses for cutting them for the relief of epilepsy, of headache and what not. It may seem strange to some of the younger men of the present day, but there was a time when the eyes were tampered with in a perfectly reckless way; however, so far as any one of that day knows, no case of epilepsy or migraine was permanently cured thereby. In saying this, however, I do not wish to cast any doubt on the importance of determining the alinement of ocular movements and of correcting these conditions according to improved methods. That much headache and dizziness may be due to disturbance in the functioning of the ocular muscles there cannot be the slightest doubt.

This matter of fine discrimination between functional and organic disturbance of the eyes has been brought home again and again, especially in medicolegal cases. I know of no more difficult task than to convince a jury or a judge of the existence of a purely functional amblyopia following a trauma.

I recall a most important medicolegal controversy over the case of an Italian sailor who fell from the ropes at a considerable height and immediately afterward claimed to be entirely blind. All sorts of opinions were given, and all sorts of remedies were suggested. A huge indemnity was claimed. I thought I had proved that there was not the slightest evidence of any organic basis for this blindness in the condition of the outer eye, nor was there any condition of the brain that could account for it. Finally the judge asked: "How can you claim that this man has vision when he sits here like an absolutely blind person?" I said to the judge: "None so blind as those who will not see." That seemed to clinch the matter, and he accepted my judgment.

By contrast, take another medicolegal case that is under my observation now, in which a man was knocked down by a taxi, the wheels going over the side of his face; within a few hours after the accident there developed marked double vision, with absolute paralysis of both external recti muscles and no other disturbance of ocular movement, the pupillary reflexes and all other muscles acting perfectly and all movements of the eyes being perfect and symmetrical, except the outward movement. Since both muscles were involved and there had been no loss of consciousness or any other serious disturbance, there was but one interpretation to give to this condition. It was positively organic and must have been due to a slight hemorrhage or possibly a slight fissuration of the skull at the base; and few, except those who know accurately the anatomy of the brain, will realize how close together the abducens nerves lie at their emergence from the lower axis of the brain. That there was no hemorrhage within the pons was evi-

dent from the fact that both abducens nerves were involved but the seventh nerves had escaped.

I have cited only a few of these facts in order to prove that there must be the closest possible relation between those who make a special study of the eyes and those who are devoted to a study of disorders of the central nervous system. I have no doubt that there are many other conditions. Some of them one is still warranted in questioning, for instance, the relation of the sinuses to involvement of the optic nerves; and by the way, nothing is more significant than the outstanding ocular symptoms in occlusion of the cerebral sinuses.

May I ask the ophthalmologists to maintain the closest possible relation with neurology, with otology and, even more, with general medicine?

THE PROPER TIME FOR OPERATION IN STRABISMUS

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At what age should patients with strabismus be operated on? This question is frequently propounded to all who are particularly interested in this phase of ophthalmology. The answer to it is not so simple as the questioner often thinks. He usually expects some concrete age to be set, but an intelligent opinion can be given only after consideration of many factors. I shall briefly review a few of the things one should know before arriving at a decision to operate.

A complete diagnosis of the motor anomaly is the first essential. Such a study should include an accurate measurement of the amount of the deviation at 20 feet (6 meters) and at 13 inches (33 cm.). For this determination I strongly urge the use of the screen and parallax test of Duane. The accuracy of this method has long been known, yet many still neglect to use it. The cruder tests can give only approximate values. They cannot measure a lateral and a vertical deviation at the same time, nor can they give reliable information about the behavior of the deviation in the six cardinal directions of gaze. One must know the amount of the deviation in each of the different directions of gaze. Routine testing in the "corners" will often reveal that a deviation thought to be concomitant is a nonconcomitant one. Notation on the presence or absence of diplopia or binocular vision should be made. Obviously estimation and correction of the refractive errors are most important, although this is not the panacea of all muscular ills that some seem to think. Careful measurement of the deviation both with and without the correction is essential. Orthoptic exercises are sometimes of value, and the effect of them should be considered. The value of all these nonoperative measures should be weighed in each case and operation advised only when one is convinced that in surgical intervention lies the only relief. Such a decision can occasionally be made at once; usually it takes several weeks or months, and in rare instances a year or two. Once it is made, I see no reason for waiting.

Those ophthalmologists who prefer to postpone an inevitable operation until some age, arbitrarly selected, has been reached cite several reasons for the delay. They raise the objection that early operation

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necessitates the use of a general anesthetic, which makes it more difficult to gage the effect. This is true; yet by a careful preoperative analysis of the deviation this danger can be reduced to a minimum. I cannot stress too strongly the importance of a careful study of the deviation before operation. If one is thoroughly familiar with the existing conditions, one can operate with much greater confidence, regardless of whether one is using a general or a local anesthetic.

In rare instances a convergent squint spontaneously disappears during the growing period. This occurs as the result of developmental changes in the structure of the orbit, by virtue of which the power of the external rectus muscles is increased while that of the internal rectus muscles is diminished. This possibly deters some surgeons from operating until full orbital growth has been reached. Such a disappearance is so rare that one hardly seems justified in delaying operation for years because of this faint hope. The dread of a secondary divergence is another deterrent to some ophthalmologists. In my opinion, most cases of secondary divergent squint result from improper operative technic rather than from operation at too early an age. However, should it occur, as occasionally happens, the operation for its correction is not particularly difficult. I agree with Duane who twenty-two years ago said, "to let a child go on for years with a convergent squint simply because in a small percentage of cases the operation for remedying the condition turns out ill, seems to me ill advised timidity."

Secondary muscular changes occur in squints of long standing. Overactive muscles become rigid, while the underactive ones become stretched and weakened. Since these muscular changes diminish the chances of success, I believe that the earlier one operates the more favorable are the muscular conditions. Postoperative diplopia, the *bête noir* of all ophthalmologists, is less likely to arise in patients operated on at an early age. Furthermore, should it occur it is much more readily overcome in early childhood than in later life. The ability to maintain fusion is also greater after an early removal of the deviation.

The presence of a disfiguring squint is a great handicap to children, from both a physical and a mental standpoint. The derisive taunts of their playmates ring in their ears incessantly. The warnings of the overzealous parents constantly remind them of their "weak eyes." It is no wonder that they so often become self-centered, eye-conscious neurotic children. Removal of the cosmetic blemish prior to school age rids them of a terrific handicap, and to my mind is the strongest reason of all for early operation. I am positive that no arbitrary age limit should be adopted. Let each case be decided on its own merits. Advise operation when the indications arise, regardless of age.

TRACHOMA IN EGYPT

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Trachoma as it occurs in Egypt is true trachoma and is identical with the disease existing in America among the Indian and white races.[1] The minor differences which are exhibited by individual patients in Egypt or in America are based, in part, on the greater chronicity of the disease in the Orient and the more active type of infection in the West. This view is supported by the observations of ophthalmologists in Egypt, who declare that while natives appear to tolerate trachoma with a definite degree of resistance to its harmful effects, Occidentals infected in the Orient show no such defense. In the latter, the disease presents a more acute and extensive inflammatory character.

On the other hand, certain clinicians regard "trachoma" as an inclusive term, or, as expressed by Wilson:[1a]

> A definition though now applicable only to trachoma may in the future be found to describe only a syndrome which may be common to several aetiologically distinct conditions or to the complications of a simpler condition.

However this may be, we have observed cases in Cairo which correspond in all respects to those seen in New York. The latter in turn exhibit all the clinical variations found in the four main types occurring in Egypt as they were originally described by MacCallan.[2]

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The officers of the Department of Public Health in the service of His Majesty, King Fuad I, His Excellency, Dr. Mohammed Shahin Pasha, Under Secretary of State, and the Members of His Excellency's Staff offered every facility for conducting this study. At the Memorial Ophthalmic Laboratory we enjoyed the privilege of working in one of the best equipped ophthalmic institutions, a modern and progressive laboratory, under the direction of Dr. Rowland P. Wilson. Dr. Wilson and his Staff, Major F. H. Stewart, Dr. A. F. Abassi and Dr. F. el-Tobgy, welcomed us cordially and gave whole-hearted assistance. Dr. H. M. Dewairy supplied us with some of our clinical material.

1. (*a*) Wilson, R. P.: Sixth Annual Report of the Giza Memorial Ophthalmic Laboratory, Cairo, Egypt, Schindler's Press, 1932. (*b*) Thygeson, P.: Am. J. Ophth. **14**:1104, 1931.

2. (*a*) Attention should be directed to the fact that almost all cases of trachoma observed by us in New York occurred among Europeans, and that in most of the patients the disease could have arisen before their emigration. (*b*) MacCallan, A. F.: Lancet **2**:919 (Oct. 30) 1926; Trachoma and Its Complications in Egypt, London, Cambridge University Press, 1913, p. 1.

Bacteriologic studies were undertaken to determine the flora of local trachomatous lesions and to compare it with that which has been found in New York. Investigations were also made with the view of disclosing, if possible, any particular agent which might have a causal relation to the Egyptian disease.

The tarsectomized tissue obtained in Cairo from uncomplicated trachoma yielded, as a rule, fewer varieties and less profuse growth of bacteria than were found in similar New York material. In Egypt, xerosis, Morax-Axenfeld and Koch-Weeks bacilli, pneumococci, streptococci (usually of the indifferent types) and gonococci were observed in stained film preparations or in cultures more frequently than in New York. In New York, on the contrary, the numerous varieties of chromogenic, gram-negative bacilli, diphtheroids and staphylococci were encountered.

A search for a hitherto undescribed microbic agent in trachoma as it exists in Egypt led us to no result worthy of description. This investigation was based on the examination of film preparations derived from uncomplicated and complicated lesions of the different stages of the disease, forty-six specimens in all. In addition, the tissue sections stained with hematoxylin and eosin and the Gram and Giemsa stains from twenty such cases were studied; and the conjunctival tissue or grattage material obtained from twenty-four patients was cultivated in leptospira medium and on horse-blood agar, by methods to be described.

We have discussed in a previous article [3] the problem of a filtrable or ultramicroscopic virus as the incitant of trachoma, and have shown from our experiments and from those of others that such a virus has not as yet been detected. Moreover, Stewart, of the Giza laboratory, will soon report negative filtration experiments with trachomatous material of Egyptian origin.

INCLUSION BODIES IN EGYPTIAN TRACHOMA

We have stated [3] that inclusion bodies of the kind characteristic of many ultramicroscopic viruses were not found in our examinations of New York cases of trachoma. Nor have we met with the so-called inclusion bodies of Prowazek-Halberstaedter (known as Prowazek bodies). The probability of these structures being of bacterial origin and not specific for trachoma was also discussed.[4]

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3. Olitsky, P. K.; Knutti, R. E., and Tyler, J. R.: J. Exper. Med. **54**:557, 1931.

4. Olitsky, P. K.: Rev. internat. du trachome **7**:173, 1930. Compare particularly Bengtson, I. A.: Am. J. Ophth. **12**:637, 1929, and Science **77**:218, 1933; also, Williams, A. W.: J. Infect. Dis. **14**:261, 1914. Olitsky, Knutti and Tyler.[3]

Stewart [5] found that definite Prowazek inclusions are absent, as a rule, in the uncomplicated type of trachoma prevailing in Egypt. On the other hand, he concluded that they are present in most cases complicated by secondary infections, especially those induced by such pathogenic bacteria as Koch-Weeks bacilli, Morax-Axenfeld bacilli, pneumococci, streptococci and gonococci. Our studies, although based on a much smaller number of observations, tend to support Stewart's findings. For example, in film preparations derived from twenty-two patients having uncomplicated trachoma (mostly of MacCallan's types I and IIa), no single case revealed Prowazek bodies; yet in similar examinations of specimens from twenty-one cases of trachoma showing superinfection by Koch-Weeks bacilli, fourteen showed definite bodies. In addition, two of four patients having trachoma with secondary Morax-Axenfeld bacilli and one with hemolytic streptococcic infections exhibited the inclusion corpuscles. The bodies were not, however, found in stained tissue sections derived from either complicated or uncomplicated trachomatous conjunctivitis. In all of these observations a distinction was made between characteristic Prowazek structures and other inclusions, particularly intracellular bacteria of ordinary species.

Wilson,[1a] in summing up the results of an analysis of examinations of trachomatous tissues and secretions for Prowazek bodies, stated:

> In Egypt the home of trachoma they are but rarely found. We therefore cannot understand how some have found them in 100 per cent of cases. We cannot believe, as it is said, that it is merely a question of the time spent over each individual case but rather we believe that there is not sufficient discrimination of the various epithelial inclusions and pseudo-inclusions which are so commonly met with.

From our experience in the Orient, we can confirm the opinion of Wilson and his associates [6] and of others [4] concerning the essential bacterial structure of the elements composing the characteristic Prowazek bodies, and conclude with Stewart that their presence is correlated with secondary bacterial infection superimposed on trachomatous lesions.

It appears, then, from studies carried out in Egypt by others and ourselves that trachoma, as it occurs there, is similar to the disease in New York, and that no fact could be brought to light revealing the identity of a hitherto unrecognized microbic or ultramicroscopic incitant.

During the course of the cultivation experiments, we isolated Bacterium granulosis. Since that micro-organism had not previously been found in Egypt [1] and in view of the significance attached to it in its

5. Stewart, F. H., cited by Wilson [1a]. A report elaborating these earlier results and based on several hundred additional observations is to be published.

6. Personal communication to the authors.

relation to human trachoma existing elsewhere,[7] the finding takes on greater interest.

RECOVERY OF BACTERIUM GRANULOSIS

Methods.—We have followed in the cultivation experiments the mode of procedure originally devised by Noguchi[7a] in his studies on trachoma. We have employed particularly the two mediums of Noguchi, the so-called leptospira medium and horse-blood agar, as modified by Olitsky, Syverton and Tyler.[8] The tissue itself and decimal dilutions of the suspension of ground conjunctival material up to 1 : 1,000 were used for inoculation. The average number of tubes of leptospira medium and blood-agar plates which served for primary inoculations in each case was eight tubes and ten plates. Following the usual practice, we examined at intervals each inoculated leptospira tube by means of (*a*) the dark-field microscope, (*b*) transplants to blood-agar plates and (*c*) a Gram stain of its contents.

Contamination of Cultures by "Nile Dust."—Contamination of cultures by dust or sand is generally encountered in countries having the physical geography of Egypt. In two preliminary cultivation tests made in an open room without vigilant control of the atmosphere, we found, especially on agar plates, such marked contamination with molds as to render cultures so made useless for study. We attempted, in the absence of a dust-proof cubicle or chamber, to control the dust in the air by keeping the windows and the door shut, spraying the room with an oily vapor and wetting the work table with a 1 : 1,000 solution of corrosive mercuric chloride. In addition, a glass box was provided, the inner surfaces of which were frequently washed with the solution, and which admitted only the worker's hands and forearms. In this small chamber most of the mediums were tubed or plated, and all of the inoculations were made except those in the leptospira medium. In the end this method served to give no more contamination than is ordinarily met with in our cultural work in New York.

Materials.—In a certain number of patients with trachoma tarsectomy is the therapeutic indication. The operation is performed as follows: After local anesthesia produced with procaine hydrochloride, the conjunctival sac is thoroughly washed by means of warm, sterile physiologic solution of sodium chloride, and the excision is made under strict aseptic conditions.

Only the removed tarsal plate with its overlying mucosa comprised the material used for cultivation tests. In addition to the two pre-

7. (*a*) Noguchi, Hideyo: J. Exper. Med. (supp. 2) **48**:1, 1928. (*b*) Olitsky, P. K.: Tr. Am. Acad. Ophth. **35**:225, 1930.

8. Olitsky, P. K.; Syverton, J. T., and Tyler, J. R.: J. Exper. Med. **57**: 871, 1933.

liminary cases mentioned in the preceding paragraphs, we obtained thirteen such tarsi. These were derived from the same number of patients having trachoma chiefly of types I, IIa and IIb of MacCallan's designations.[2b] Of the thirteen, however, two tarsi offered control material, for they were removed from patients having type III trachoma;[9] that is, they showed follicles in the retrotarsal fold but not over the diffusely scarred tarsal plates.

Use of Tarsectomized Tissue.—Noguchi and ourselves have employed for cultivation and transmission experiments tarsectomized tissue, since it is more suitable for these purposes. Also, Bengtson[10] has recently stated that the chances for successful transmission to animals and for isolation of Bacterium granulosis are greatly enhanced by the use of the larger amounts of material yielded by excised tarsi. It is noteworthy that prior tests in Egypt by others[1] employing chiefly material expressed from follicles or procured by means of conjunctival grattage failed to yield positive cultures.

Besides the studies made with excised tissue, we cultivated the substance obtained by conjunctival grattage—an operation performed for therapeutic purposes—from four added cases of types I and IIa trachoma. Contamination by many different kinds of micro-organisms, especially molds, was so frequent and showed itself by overgrowth of cultures so early, within from twenty-four to forty-eight hours, that these cultures were found valueless for the isolation of fragile and slowly growing bacteria. In any event, Bacterium granulosis was not recovered from the scraped conjunctival material. In performing cultivation tests, particularly in Egypt, it is therefore essential to pay special attention to the bacteriologic cleanliness of the technic, and, *pari passu*, to use tarsectomized tissue as the inoculum.

Identification of Cultures.—The morphology of Bacterium granulosis and its cultural characteristics in the leptospira medium, on horse-blood agar and on plain agar are distinctive; these were the criteria for its identification. Fermentation reactions with different carbohydrates were not studied in view of the irregular results which were previously obtained in different tests with the same strains of bacteria. The final determination of the species of micro-organism involved was made by means of serologic examination. We used for this purpose specific rabbit agglutinating antiserum of a titer of 1 : 10,000 prepared with a strain

9. Briefly, these types of MacCallan, so widely used now by clinicians in the diagnosis of trachoma, describe: the early disease with its initial follicles, which in Egypt first appear over the tarsus, and in the Occident, in the fornix (type I); the intermediate stage, in which follicles predominate (type IIa) or papillary hypertrophy develops along with the follicles (type IIb), and a later stage, of beginning cicatrization (type III).

10. Bengtson, I. A.: Science **77**: 218, 1933.

of Bacterium granulosis isolated from a case of trachoma in New York. In all instances in which a culture was finally designated as that of Bacterium granulosis, the serum agglutinated such a strain in a dilution of at least 1:1,000. Indeed, no morphologic, cultural or serologic difference could be shown to exist between the Giza strains of granulosis organism and other cultures now in our possession. The latter cultures were ultimately recovered from patients having trachoma who resided in America (New York, Chicago, St. Louis, Denver and Albuquerque, Fort Defiance and Leupp, Ariz.), in Tunis and in Italy. The Egyptian strains were also found to be identical with those isolated in New York from the conjunctival tissue of monkeys having granular conjunctivitis as a result of inoculation of human trachomatous tissues or cultures of Bacterium granulosis.

It should be emphasized that only from one to four colonies of Bacterium granulosis could be found on an intial plate culture. In other cases, the growth was sometimes seen as an offshoot from a larger colony of another micro-organism, usually a staphylococcus, in which case a quarter moon-shaped excrescence arose from the margin of the larger colony. Under such conditions, Bacterium granulosis could easily be overlooked. In still other instances, overgrowth at the site of a colony of Bacterium granulosis rapidly took place from adjacent micro-organisms of other species, when complete suppression or disappearance of the granulosis organism occurred. Thus, because of sparse growth, symbiosis with other colonies and overgrowth or suppression of the slowly growing Bacterium granulosis by more rapidly growing bacteria or molds, sources of error may arise and account for discrepancies in the efforts at isolation by different experimenters.

Numerical Results of Cultures.[11]—The tarsectomized tissue for cultivation tests was procured from two patients with trachoma having scarred conjunctivae and from eleven showing a preponderance of follicles.

The two scarred conjunctival tissues yielded only a few micro-organisms both in the leptospira medium and on blood-agar plates. These were mainly molds and diphtheroids and probably arose from sources other than the tissues themselves, for in the sections stained by the Gram and Giemsa stains, no organisms could be found. Bacterium granulosis was not recovered in these two instances.

11. In addition to the number of tarsectomized tissues cultivated as mentioned, there were five which were received in the last days of our stay in Giza. Three of them were rapidly overgrown by molds, owing to contamination of the tissue itself before cultivation, and two could not be studied thoroughly owing to lack of time. In none of the five was any organism noted during the period of observation which deserved special attention. In ordinary routine practice, a culture is usually studied for an average period of twelve days from the time of initial inoculation, unless an earlier positive result is obtained.

Of the eleven tarsi removed from patients with trachoma showing the follicular type I or IIa disease, four yielded cultures of Bacterium granulosis.

The first positive result was observed in the case of an Egyptian woman, aged 25, who had an attack of acute follicular trachoma (type I) for a month prior to tarsectomy. The acute disease was superimposed on a preexisting type IIa trachoma and was characterized by pannus tenuis of indefinite duration but assumed from the patient's history to have existed for several years. Bacterium granulosis was recovered from the blood-agar plate culture. A morphologically similar organism also appeared in the leptospira medium, but this was not followed after a pure culture was obtained from the plate. The associated organisms were staphylococci, diphtheroids and gram-negative diplobacilli.

The second positive culture was obtained from an excised tarsus of an Egyptian girl, aged 13 years. She had trachoma, probably since infancy, and at the time of tarsectomy the disease was manifest as type IIa with an added secondary infection caused by Koch-Weeks bacilli. The patient exhibited injected palpebral and bulbar conjunctivae, a mucopurulent secretion, phlyctenules at the limbus and in the palpebral conjunctivae, follicles and fine, streaked scars. The condition was accompanied by pannus crassus. The leptospira medium and plate cultures yielded Bacterium granulosis and only one associated organism, the Koch-Weeks bacillus.

The third culture of the granulosis organism occurred in the case of an Egyptian boy, aged 8 years, who had trachoma (type I) associated with secretion, Herbert's pits and pannus tenuis. The disease may have endured since infancy. The micro-organism was recovered only from the plate cultures; the concomitant bacteria met with were Bacillus xerosis and staphylococci.

The fourth and last positive culture was obtained in the case of an Egyptian girl, aged 12 years, who had trachoma probably since infancy and exhibited definitely the type IIa disease. Follicles predominated in the lesions, and Herbert's pits and pannus tenuis were also visible. Bacterium granulosis was isolated on the blood-agar plates five days after seeding; the inoculated leptospira medium was not studied. The associated micro-organisms in this case were Morax-Axenfeld bacilli and molds.

In sections of the conjunctival tissues secured from the aforementioned eleven cases of trachoma and stained by the Gram and Giemsa stains, we found within the lesions small, gram-negative bacilli lying singly or in clumps of from 3 to 6 organisms. Morphologically, they resembled Bacterium granulosis and were observed in the four tissues from which cultures of Bacterium were obtained as well as in four in which such cultures failed.

Inoculation of Monkeys.—During our stay in Egypt, there were available for our use only four Macacus sinicus monkeys.

The monkeys had smooth conjunctivae, and each was inoculated in the upper left lid, after complete ether anesthesia, with two pooled Giza strains (nos. 5 and 6) of Bacterium granulosis. Two-tenths cubic centimeter of the bacterial suspension was injected subconjunctivally, followed by scarification in accordance with the usual procedure.[7a]

Monkey A: After seven days this animal exhibited in the upper part of the left conjunctiva several small, discrete follicles accompanied by redness, congestion, edema and roughness of the membrane. These lesions became more marked, particularly with regard to enlargement of the follicles, during the course

of observation extending over the following two weeks. Fourteen days after the first appearance of the reaction in the inoculated conjunctiva, the right, or uninoculated, lid showed several small and large follicles, redness, roughness, edema and congestion.

Monkey B: This monkey reacted similarly to monkey A, with the exception that a mucopurulent secretion accompanied the lesions in the two eyes.

Monkey C: Two weeks after inoculation granular conjunctivitis developed in both the inoculated and the uninoculated conjunctiva, but the signs were more marked in the former. After another week, secretion accompanied the lesions in both eyes, and definite progression and extension of the conjunctival changes were noted.

Monkey D: The first changes of granular conjunctivitis in the inoculated conjunctiva appeared two weeks after inoculation, and extension to the uninoculated eye occurred a week later. In this animal a mucopurulent secretion was also observed.

It appears, then, that the Giza strains of Bacterium granulosis induce in the sinicus monkeys a progressive granular conjunctivitis, first appearing, from seven to fourteen days after injection, in the inoculated lid, and then spreading by contact, within a period up to two weeks later, to the uninoculated eye. The general appearance of the disease produced experimentally in Macacus sinicus monkeys is similar, though less marked, to that produced in New York in rhesus monkeys by other occidental strains of Bacterium granulosis.[12]

SUMMARY AND CONCLUSIONS

The bacteriologic studies of trachoma occurring in Egypt led us to conclude that no essential differences exist between the disease encountered there and the disease existing in the United States. The minor differences may be ascribed to a variation of the terrain or to racial susceptibility. The disease is more prevalent in Egypt, and the native adapts himself to its ravages with a greater degree of resistance.

In our studies made in New York we have failed, with the exception of confirming Noguchi's conclusions concerning Bacterium granulosis, to implicate another factor in a causal relation to the disease. So also in our studies made in Egypt, while more light was cast on the bacteriologic problem of the disease, they did not disclose evidence which might change the status already established for Bacterium granulosis in trachoma in human beings.

That Bacterium granulosis can be isolated from certain cases of trachoma as it occurs in Egypt by the methods we have herewith described is now apparent. The organisms thus recovered are evidently

12. On our return to New York, we pooled the four Egyptian strains and inoculated subconjunctivally with this material five Macacus rhesus monkeys. Within from six to eighteen days four of the animals had characteristic progressive granular conjunctivitis.

identical in morphologic, cultural and serologic characteristics with those obtained from patients having trachoma and residing in other parts of the world. The Egyptian strains of Bacterium granulosis are also pathogenic for monkeys in practically the same way as are the cultures derived from occidental sources.

In view of our failure to discover in Egypt any other causal agent of the disease, and from the positive findings regarding Bacterium granulosis, the original conclusions of Noguchi on the causal relation of Bacterium granulosis to trachoma in human beings have received additional support.

CIRCULATION OF THE AQUEOUS

III. THE REABSORPTION OF CRYSTALLOIDS

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AND
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In a previous communication,[1] we have reported the results of our studies relating to the mechanism of the reabsorption of fluid from the eye, and outlined a hypothesis as to how this mechanism operates. The reabsorption of fluid behind the iris was inappreciably small, but, on the other hand, the reabsorption from the anterior chamber was subject to large and predictable variations. The chief factors favoring the reabsorption were found to be a rise in the intra-ocular pressure and an increased congestion of the anterior ocular blood vessels. Since congestion of the vessels of the iris, in the light of all of our present knowledge regarding capillary premeability, should lead to an increased rate of formation of aqueous rather than to an increased rate of reabsorption, we were forced to the conclusion that the chief factor in the reabsorption mechanism is Schlemm's canal.

The vascular connections of Schlemm's canal, as worked out by Henderson,[2] and the fact that the canal appears normally to contain only small amounts of blood or plasma, lend themselves readily to the hypothesis that congestion of the anterior ocular vessels is associated with an increased flow of plasma into Schlemm's canal, resulting in an increase in the osmotic pressure of the protein within the canal, and, therefore, an increased rate of reabsorption of fluid.

It follows from this hypothesis that the reabsorption of crystalloids from the anterior chamber should, in large measure, be independent of the rate of reabsorption of water, since the former may diffuse into all the adjacent vessels irrespective of the hydrostatic pressure within them. The study of the mechanism of reabsorption of crystalloids becomes, therefore, a necessary test of the validity of the hypothesis which we have formulated.

From the Wilmer Ophthalmological Institute of the Johns Hopkins University and Hospital.

1. Friedenwald, J. S., and Pierce, H. F.: Circulation of the Aqueous: II. Mechanism of Reabsorption of Fluid, Arch. Ophth. **8**:9 (July) 1932.

2. Henderson, T.: Glaucoma, London, E. Arnold, 1910.

The technic for such a study was established by Kronfeld,[3] who investigated the rate of disappearance of dextrose and iodide from the anterior chamber as follows: The cornea was punctured with a needle attached to a syringe containing 10 cc. of a solution of the test substance isotonic with the normal aqueous. The piston of the syringe was then moved backward and forward, resulting in a mixture of the aqueous with the test solution. When a good mixture was thought to have been obtained, the anterior chamber was filled up to the normal intra-ocular pressure, and the point of the needle was plunged through the cornea on the side opposite to the puncture and the syringe disconnected. In this way any leakage of the solution through the puncture holes was avoided. After a varying lapse of time in different experiments, the anterior chamber was again tapped, and the concentration of the test substances remaining in the anterior chamber was compared with that in the syringe used for mixing and injections.

Kronfeld found that the rate of absorption of iodide was greater than that of dextrose, as might have been supposed on account of the smaller molecular weight of the former. He was able, moreover, to compare the rate at which iodide disappeared from the aqueous when injected in this way with the rate of its appearance in the aqueous following intravenous injection. It was found that the permeability of the blood-aqueous barrier as tested in these experiments was the same no matter in which direction diffusion occurs.

Our own experiments were performed on dogs under intravenous sodium barbital anesthesia. Except where otherwise stated, this was supplemented by the instillation of 1 per cent solution of cocaine into the conjunctival sac. Eosin, dissolved in physiologic solution of sodium chloride, was used as the test substance. Only 0.5 cc. of the test solution was introduced into the injecting syringe, since this was found to give a better mixture with the aqueous on fewer movements of the plunger than the 10 cc. used by Kronfeld. The concentration of the dye was measured colorimetrically.

If the escape of the test substance from the anterior chamber is simply due to diffusion into the adjacent blood channels, the percentage lost per minute should be a constant fraction of the amount of the substance in the anterior chamber at that time, and the logarithm of the concentration in the anterior chamber should be a linear function of the time elapsed since injection. In chart 1, we have plotted our own results with eosin and, also, Kronfeld's results with dextrose and iodide on a logarithmic scale. It is clear that the law of diffusion is obeyed, and that the percentage of eosin reabsorbed per minute is the same whether the concentration at the beginning of the experiment was 0.5

3. Kronfeld, P.: Verhandl. d. deutsch. ophth. Gesellsch. **49**:296, 1932.

or 0.0125 per cent. Kronfeld's results, also, fall on a straight line except for a slight discrepancy in the initial concentration, due, perhaps, to incomplete mixing of the aqueous with the fluid in the syringe.

It is noteworthy that the slope of the curve for dextrose is practically the same as that for eosin, the molecular weight of the two being of the same order of magnitude, while the curve for iodide, which is more diffusible, has a steeper slope. From these curves the percentage absorbed per minute, as previously defined, can be calculated, and in what follows the results will be given in these terms. For eosin and dextrose, the amount absorbed per minute is approximately 2 per cent; for iodide, approximately 4 per cent. To compare this with the water

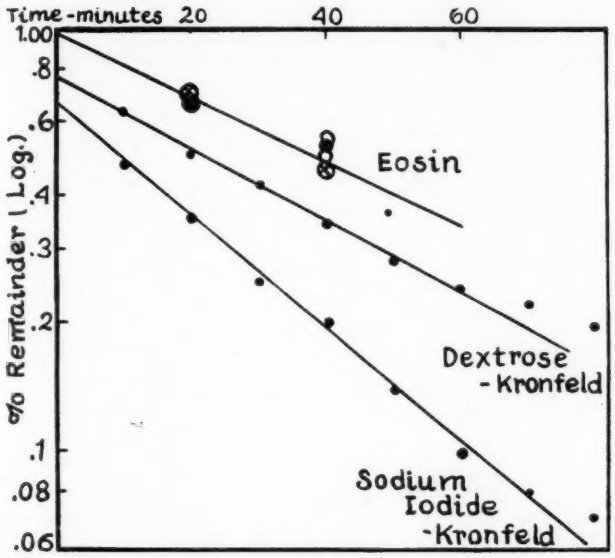

Chart 1.—Rates of absorption of eosin and of dextrose and sodium iodide (Kronfeld) from the anterior chamber, plotted on a logarithmic scale. The circle indicates initial concentration of 0.5 per cent; the solid circle, of 0.25 per cent, and the cross, of 0.06 per cent.

exchange, we note that the volume of the anterior chamber of dogs' eyes is nearly 0.5 cc. As determined previously, the normal rate of reabsorption of fluid from a dog's eye is of the order of 1 cu. mm. per minute, or 0.2 per cent of the volume of aqueous. As predicted by theory, the disappearance of these crystalloids cannot be accounted for by supposing them to be simply washed out of the anterior chamber with the circulating water.

Having arrived at the normal rate of reabsorption of eosin, the experiments were now repeated on animals the pupils of which had been dilated with atropine or contracted with physostigmine (eserine). In chart 2, the rate of reabsorption per minute in these experiments is

plotted against the area of the iris. Again we find a linear function, but it is interesting that when we extrapolate this curve to the point for zero area of the iris an appreciable rate of absorption remains, indicating that some absorption of crystalloids (roughly 20 per cent) takes place through Schlemm's canal, and perhaps, also, by direct diffusion into the surrounding nonvascular tissues.

In a third series of experiments, small amounts of histamine or of epinephrine were injected into the anterior chamber together with the solution of eosin, and, after correction for the area of the iris, it was found that the rate of absorption of eosin was greater when the vessels of the iris were congested with histamine, and was less when these were constricted with epinephrine.

In summary, these experiments completely support the conception that the reabsorption of crystalloids from the anterior chamber takes

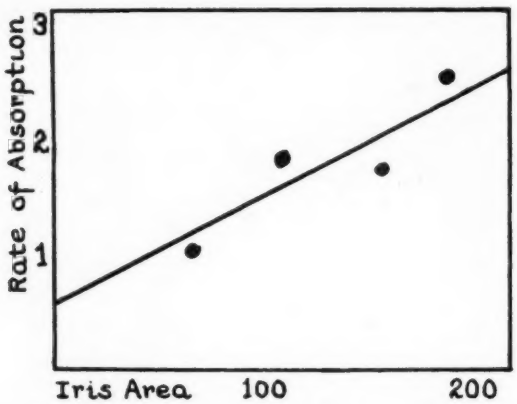

Chart 2.—Rate of absorption of eosin, in percentage per minute, versus the area of the iris in milimeters squared.

place by simple diffusion, mainly, into the vessels of the iris. The rate of reabsorption is dependent on the area and degree of hyperemia of the iris. In fact, we can use the rate of reabsorption of eosin as a measure of the congestion of the iris.

In the previously reported experiments, we had found that the instillation of irritating solutions, particularly of weak solutions of ammonia, into the conjunctival sac resulted in a marked increase in the rate of reabsorption of water from the anterior chamber. Applying this irritant in experiments on the rate of absorption of eosin, we find that no change in the rate of absorption results. In these experiments, the local instillation of cocaine was omitted, and the rate of absorption was somewhat greater both in the irritated eye and in the control eye than in instances in which cocaine was used. We may conclude that the puncture of the cornea produces a vasomotor reflex involving the vessels

of the iris which is suppressed by cocaine, but that the conjunctival irritation with ammonia results in no further reaction of these vessels. Since this same irritant applied in the same way increases the rate of reabsorption of water, we have here clear evidence of the complexity and independence of the various parts of the intra-ocular vasomotor system.

In measuring the effect of increased intra-ocular pressure on the rate of absorption of the dye, the same type of experiment was performed, but, after introducing the dye, the anterior chamber was connected through a flow meter with a reservoir of salt solution which could be set at any desired level. After the fluid was allowed to flow

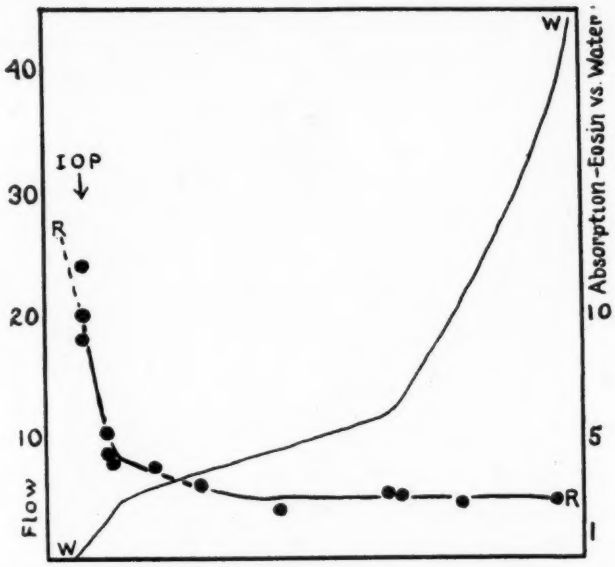

Chart 3.—Effect of increased intra-ocular pressure on the rate of absorption of eosin and water. Curve *W-W* shows water absorption with varying intra-ocular pressure; curve *R-R*, ratio of the absorption rate of eosin to that of water at various levels of intra-ocular pressure. *I.O.P.* denotes the normal level of intra-ocular pressure.

into the eye under any desired pressure for twenty minutes, the stopcock connecting the anterior chamber with the reservoir was closed, and the contents of the anterior chamber were removed for analysis. Chart 3 shows the results of these determinations. As the pressure is raised, the rate of absorption of water increases. We have presented elsewhere [1] a detailed analysis of the relations between the rise in pressure and the rate of absorption of water, and have concluded from this analysis that a certain degree of intra-ocular congestion must accompany the rise in intra-ocular pressure. This conclusion is confirmed by our finding in the present experiment, for as the pressure is increased the

rate of absorption of the dye also increases. The increased absorption of the dye, however, is not proportional to the increased absorption of water. At normal intra-ocular pressure, as previously stated, the percentage of dye absorbed per minute is ten times the percentage by volumes of water absorbed. In the region of the plateau of the pressure vs. flow curves, the ratio of dye to water absorption is 4 : 1. At pressure levels above the plateau, the ratio drops to 2.5 : 1. All of these findings are in accord with the hypothesis as to the mechanism of the reabsorptive process which we have suggested.

CONCLUSIONS

1. The reabsorption of crystalloids from the anterior chamber takes place by diffusion. The major fraction diffuses into the vessels of the iris, but a small proportion leaves the eye by way of Schlemm's canal, and possibly, also, through nonvascular tissues.

2. The rate of absorption depends on the area of iris exposed to the anterior chamber and on the degree of hyperemia of the iris.

3. The vasomotor controls of the vascular connection of Schlemm's canal and of the vessels in the iris are to a certain degree independent of one another.

4. When the intra-ocular pressure is raised, the rate of absorption of water increases more rapidly than that of foreign crystalloids introduced into the anterior chamber.

ESOPHORIA AND EXOPHORIA AS THE CAUSE OF OBSTINATE ASTHENOPIA

CURE BY SURGICAL AND OTHER MEANS

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Deviations from the normal parallelism of the visual axes may be divided, for the sake of convenience, into phorias, tropias and squints. In this arrangement the tropias are defined as more than a phoria and less than a squint. These are the deviations which frequently cause profound disturbances.

I shall briefly cite a case of esophoria and one of exophoria as an example.

The case of esophoria was that of a man of 27 years, large of frame and vigorous, who was highly educated and cultured and had a delicately balanced nervous system. His business was suffering on account of his inability to give it the required attention. He had diplopia of 20 prism degrees for distant and near vision with the red glass. With the Maddox rod there was esophoria of 20 degrees for distant and near vision. There was an inconstant diplopia which was the same in all directions when measured on the screen. Adduction was 28 prism degrees with no measurable abduction. The convergence near point was 4 cm. Rotations were normal. A searching physical survey revealed a healthy and unusually vigorous person.

A Jameson recession of 4 mm. of the right median rectus muscle was done. Three days after the operation there was no diplopia, and the Maddox rod measured 2 degrees of esophoria for distant vision and balance for near vision. The symptoms are entirely relieved.

The case of exophoria was that of a woman 60 years of age, who was unable to read or write because of diplopia. It was necessary for her to do clerical work, but impossible to do so for more than an hour when diplopia supervened and she could continue only by covering one eye. There was much mental confusion, so that she feared she was losing her mind. She became sleepless and nervous, and her temperament changed. From a cheerful, sunny person, she became melancholy, moody and depressed and contemplated self-destruction.

The vision was normal with correction which was hypermetropic. There were 23 prism degrees of exotropia for distant vision and 35 degrees for near vision with a red glass. The convergence near point was 20 cm. There was a left hyperphoria of 6 degrees for distant and near vision. It was not possible to measure the ductions on account of suppression. A Reese resection of 4 mm. of the right median rectus muscle was done together with a Jameson recession of the right lateral rectus muscle of 4 mm. The result after a month was exophoria of 2 degrees for distant vision and esophoria of 6 degrees for near vision, with left hyperphoria of 2 degrees for distant and near vision. With proper correction, including prisms for correction of the hyperphoria, there was perfect comfort, which has remained for four years.

Read before the Cleveland Ophthalmological Club, November, 1932.

ESOPHORIA

I shall first consider esophoria, which at times may become esotropia. Probably such cases exist from birth and would become convergent strabismus were not the fusion sense strong enough to prevent it.

It is this strong fusion sense which causes severe symptoms, because of the conflict set up by the strong desire for binocular single vision, and the neuromuscular imbalance of divergence or convergence resulting in esophoria or a preponderance of convergence.

The strain becomes progressively greater as age advances. A young child may have 10 or more prism degrees of esophoria without symptoms. He does not use his eyes to any great extent for near work; his life is free from care and largely out-of-doors. He probably has vigorous health.

The usual asthenopic symptoms of ocular muscle imbalance are quite familiar: headache, discomfort and ocular fatigue on reading and chronic blepharoconjunctivitis. Far-reaching effects may be seen, more particularly in persons possessing high-strung nervous systems. Persons with esotropia not infrequently have blurring of vision when fatigued, on excitation of emotions, etc.; this affects the finer coordination necessary in athletics, and hence the esophoric person will be eliminated because he falls below standard. The ill effects are obvious, since this throws him to himself. He may read too much, take too little exercise or develop many bad habits of mind and body. The child may become neurotic, sleep poorly and generally be nervously unstable. Esophoria is of great importance in aviation. One cannot see what the ultimate development of air transportation will be, but that it will absorb many thousands of young people cannot be doubted. One of the great urges to the cure of esophoria in early life is to secure proper coordination and third degree fusion in order that a boy may successfully pass aviation tests and tests for the military service.

In looking over the histories of a large number of cases of esophoria, the following symptoms were noted:

(*a*) Headaches: worse on near work, on going to the theater or driving in an automobile.

(*b*) Blurring of vision on extended reading or on fatigue from any cause.

(*c*) Diplopia: on fatigue, when ill or after long hours of near work.

(*d*) Ocular pain or discomfort: burning or redness of the eyes; conscious of the eyes at all times; somnolence on reading.

(*e*) Nervousness, nausea or extreme restlessness after a day's work at which the eyes were used.

(*f*) History of years' or life-long discomfort unrelieved by glasses or other measures.

An esophoria that causes moderate discomfort in youth and young adult life, may, as age advances, produce symptoms that greatly

handicap the person in his work. So long as he is well, does not overwork, takes proper care of himself and is in good condition, his nervous system carries the extra load. If a crisis comes in his business or domestic life or an illness or a long period of confinement which devitalizes him, his ocular symptoms become so severe he can carry on only with great difficulty, or not at all. There may be incapacitating headache, insomnia or digestive disturbances. Hence, in the treatment of esophoria one should consider these far-reaching results. The cure of this condition is much more easily obtained in youth than later in life. The earlier the cure is undertaken, the easier it may be accomplished and the better the result.

In testing the esophoric person one should test with the muscle light, then with the test letters for distant vision and with the Jaeger test type for near vision. Frequently esophoria or esotropia will be twice the amount when the patient is accommodating, as he is when looking at the test letters, that it is when he is looking at the light, when he may not accommodate.

All persons with esophoria do not have severe symptoms; some have no symptoms even with estropia. The symptoms may be masked and not referable to the eyes, but may be those of reflex irritation of the nervous system. Careful study and repeated tests are necessary to reach a conclusion.

Several kinds of tests are desirable. With the Maddox rod over the nonfixing eye, this eye should be alternately covered and uncovered to bring out the major portion of the esophoria. The screen test should be used, with the red glass over the nonfixing eye. In doubtful cases recourse to patching may be had. There are those who advocate this highly.

It is important to know accurately the ductions. The esophoria should, of course, be tested for distant and near vision with and without correction of the refraction. If esophoria has been determined as the cause of the symptoms, what is the method of treatment? The treatment may be divided into: (1) attention to the health of the patient, (2) correction of the refraction, (3) the wearing of prisms, (4) muscle exercises and (5) surgical correction.

When the esophoria is of marked degree and the symptoms are severe, my experience has been that surgical intervention is the only cure; other treatments are symptomatic only, and may relieve the symptoms but do not cure the condition.

Attention to the health of the patient is most important, and he should receive skilled and minute study. In children this is particularly important. Many children have no out-of-door play, or too little of it; they may read for many hours at a time, possibly before breakfast. They may be in school too many hours for their immature years.

A symptomatic esophoria may be a barometer of the health of the person; a nonsymptomatic esophoria may become symptomatic under reduced vitality.

Correction of the refraction is necessary and important. In this connection several factors may be considered.

Esophoria may be aggravated by the correction of myopia; undercorrection may be necessary, particularly for near work. The patient may not be able to wear myopic correction unless the esophoria is corrected by prisms, if this is possible, or in some other manner.

In hypermetropia, as is well known, it is the custom to correct fully or nearly fully this refractive error in the presence of esophoria. This frequently lessens the esophoria, at least for a time. In adults it is often efficacious to a considerable degree, but does not cure the esophoria. In those persons far enough advanced in life to wear glasses continuously without detriment, it may in many cases give sufficient comfort. In childhood and youth glasses are a real and crippling handicap. The cure may be worse than the disease.

The glasses are mechanically annoying. They make one more drag for the little chap; they are forever being broken or needing adjustment. He is subject to comments from his schoolmates which in no wise add to his peace of mind. He may become quarrelsome, or if he is sensitive he may be thrown in on himself with all of the bad consequences incident to such a mental condition. The psychologic effect of the continuous wearing of glasses in childhood is unquestionably bad. It handicaps athletics and makes for poor physical development, timidity and various maladjustments. It is a matter that should be given more consideration by ophthalmologists. The charlatan who cures all ocular troubles by exercises is the unconscious protest of the public against glasses.

In childhood when full hypermetropic correction is worn for several years there results a weakening of accommodation, so that the patient has but indistinct distant or near vision without his glasses. As a result, he must wear glasses the remainder of his life.

The wearing of prisms is subject to somewhat the same objections, in that the patient can never do without them once he is thoroughly habituated to them. They may be helpful in some cases in those beyond adolescence. They are not well adapted to adolescence and childhood.

Given a case of a person working in an office and beyond 35 years of age, one can see no reason for not prescribing prisms for the correction of esophoria. On the contrary, for a child of school age or for an active out-of-door man, like an officer in the army or navy, the wearing of prisms constantly is obviously not practicable. The wearing of glasses on the bridge of a ship is quite beyond consideration.

The mechanical and optical objections to the wearing of prisms are considerable. When sufficiently strong to correct an exophoria of any considerable degree, they are heavy and their appearance is decidedly objectionable. Chromatic aberration and other optical reasons make them objectionable. Owing to these objections, not more than 8 prism degrees may be prescribed. This much correction is heavy, awkward and impractical with few exceptions. As a temporary measure and under certain other conditions, prisms may be helpful, but they should not be relied on as a routine measure. They do not cure the esophoria.

The use of abductive exercises in esophoria has not been found to be of value. Fusion training exercises may be used in young children as is done in the attempt to cure convergent squint. One questions their value. On occasion they seem to be helpful when good cooperation of the mother and the child can be assured. It seems to have been of help in a few cases in my experience, but this was possibly a mental and psychologic effect rather than an effect on the esophoria.

Surgical measures offer a solution. This is not intended to mean that operation should be done indiscriminately in all cases of esophoria. Careful study and consideration should be given to each case over a considerable period of time before operation is recommended.

One may recognize in certain cases an essential esophoria; that is, one in which the error is fairly constant in degree for both distant and near vision, usually moderately increased for near vision, and constant at all times, varying but little under different conditions. It is little influenced by correction of refractive errors. It varies little as age advances, though there is a tendency to an increase in degree.

Many such cases are asymptomatic, and one presumes either that the patient is of unusual bodily vigor, with strong fusion, or that there is uniocular vision; that is, there is an intermittent alternating squint which thus relieves to some extent the strain on fusion and convergence. In other persons the symptoms of an essential esophoria are marked and continuous, as exemplified in the first case reported.

When the diagnosis of essential esophoria is established and there are marked symptoms, a cure may be expected only by surgical intervention. One finds that such persons frequently show 20 degrees of esophoria with the Maddox rod and the same number of degrees of esotropia with the red glass, that the measurements for distant and near vision are approximately the same, and that they are influenced but little by correction of the refractive error. In fact, there may be no refractive error, or there may be myopia. In such cases it has been my experience that a carefully computed Jameson recession operation brings relief.

One should measure the ductions if possible. There may be so much suppression of the images that obtaining the ductions is difficult or impossible. In children, obviously, the ductions are difficult to obtain.

The near point should be carefully taken. In other words, one should determine if the esophoria or esotropia is primarily due to convergence excess or divergence insufficiency.

If the near point is beyond 50 mm., the esophoria (or esotropia) is the same or greater for distant than for near vision, and adduction is not increased, it is obvious that the condition is largely due to divergence insufficiency, and the operative procedure had best be applied to the lateral rectus muscles. On the contrary, when the near point of convergence is nearer than 50 mm. and the esophoria is greater at 33 cm. than at infinity, and when adduction is supernormal and abduction subnormal, it is clear that one is dealing with a convergence excess, and the operative procedures should be directed to weakening of this function, i. e., a weakening of the median rectus muscle.

In children it has been my experience that an attempt to gage the effect is less accurate in shortening operations than in recession.

Esophoria or esotropia due to divergence insufficiency is observed less frequently than that due to convergence excess. The large majority of persons with esophoria have a convergence excess, though there may be coupled with it a divergence insufficiency.

Dr. Jameson, in discussing convergent squint, spoke of these cases in terms of tension, and this is of great value. It gives one a clearer understanding of the disordered function involved. He said that the deviation alone should not be taken as the only guide to the treatment. Careful investigation of the conditions underlying the deviation will reveal what should be done and the best procedure to be used. Computation must include all the underlying factors. Jameson further remarked that underlying pathologic conditions, palsies, macular degeneration and congenital defects must be recognized and when present may point to the futility of long-continued therapy. The following will influence in a great degree the result of surgical measures: muscular hypertrophies, insertional anomalies and typical and atypical retraction syndrome. "It is the multiplicity in causation which contributes to that erratic residue of noncorrection which can be reduced but never altogether eliminated."

In those cases in which the convergence near point is 50 mm. or less and the esophoria for near is greater than that for distance, hypertension is the underlying condition. Most esophorias and esotropias are of this type. The lateral rectus muscle may be quite overpowered, and prism abduction may be reduced or absent and external rotation decreased. The musculature may be greatly in excess of the normal, highly tense and resistant to abduction. This may be ascertained by traction on the eye by means of the strabismus hook or fixation forceps after the muscle has been tenotomized. The cited statements of Dr. Jameson refer to

squint. They are equally applicable to esophoria, which is in reality a nonmanifest or latent squint.

In such cases in which the esophoria is highly symptomatic, when there is 10 degrees or more of esophoria for distance and when constitutional causes can be eliminated, the Jameson recession is definitely indicated. In a large percentage of these cases immediate relief will be secured. It has been found, however, that not infrequently the esophoria is eliminated for a time, but returns in lesser or even the same degree after some months. Hence, I do not consider such persons cured until they have been under observation over a period of a year, since recession of the other median rectus muscle may be indicated. The patient is informed of the time required and the possibility of two sittings.

In a properly performed recession, the reaction is slight or absent. In adolescents or adults local anesthesia is used, and the patient may continue with his work after twenty-four hours, and omit the bandage in forty-eight hours. The extreme simplicity of technic, the absence of trauma, the short period of incapacity and the absence of complications have, in my experience, placed the surgical cure in selected cases of esophoria on a safe and sound basis. In over four hundred persons operated on by this method there has been no complication except in one in whom infection took place. In this person there was no ill result, and the eye recovered perfectly.

One hears objections to the danger of the scleral suture. I do not think that this point is well taken. Recession is not an operation for a tyro. The surgeon could have no excuse for perforating the sclera. If the technic as given by Dr. Jameson is followed and his needle used, perforation will not occur. Infection should be no more dangerous than in any other operation on the muscle, and certainly infection should develop extremely rarely or not at all.

Following the Jameson recession the eyes have a readjustment ability that is remarkable. It is the strongest recommendation for the use of this procedure in those cases in which lessening of tension on the median rectus muscles is indicated. This readjustment is immediate and the relief of the patient prompt. This has been observed not only in esophoria and esotropia but also in the relief of convergent squint in children. The explanation lies probably in the relief of the hypertension on the musculature. The median rectus muscle is short and tense, dragging the eye mediad. This places tension on the lateral rectus muscle so that there is tenseness of the lateral muscles and the capsule. This is increased only if one shortens the lateral rectus without releasing the median rectus muscle.

This hypertension is undoubtedly one cause of the discomfort of esophoria of this type. This same discomfort is present in children with

esophoria, esotropia or hypertensive convergent squint. Children, however, do not know where to localize their discomfort; hence it expresses itself in various nervous manifestations such as sleeplessness or night terrors, naughtiness and emotionalism of various kinds.

The remarkable restitution of the normal conditions of the eyes following a Jameson recession is undoubtedly due to the relief of tension on the whole capsulomuscular system; it is obvious that with a hypertensive internus, with its secondary attachments, and an overstretched externus the other muscles of the eye are likewise under increased tension. The superior and inferior rectus muscles aid in adduction (do they also aid in convergence?) and the oblique muscles aid in abduction; hence it is easy to see that the whole musculature of the eye is placed under abnormal tension. While it may be theorizing, one can but wonder, when one remembers the reciprocal innervation of the eyes, if the musculature of the fixing eye may not also be involved.

EXOPHORIA

Exophoria and exotropia, while less frequent, are also the cause of extreme discomfort or may be incapacitating. They may be divided into five classes: (1) those due to constitutional disease, (2) those due to refractive errors, (3) those due to anatomic or muscular abnormalities, (4) those due to defective vision and (5) those due to so-called essential exophoria.

The majority of cases of exophoria in adolescence are of the nonessential type and hence amenable to treatment by means other than surgical. One may note that this is the opposite of esophoria.

The etiology of exophoria is diverse. Thus, constitutional causes, as asthenia from any cause, anemia, ill health, constitutional inferiority, overwork and poor muscular tone from lack of exercise, may be the cause of weakened convergence power resulting in exophoria or exotropia.

Such cases respond to treatment in proportion as the patient gains strength and vigor. In this connection it should be noted that it is most important to rule out diseases of the nose and throat that might have a bearing on the etiology of the exophoria. This is true, of course, in all muscular imbalances.

A certain percentage of cases of exophoria are due to myopia. The correction of the myopia does not always correct the exophoria. The correction of the refractive error, whether it is myopic or otherwise, may relieve the symptoms, though the exophoria remains the same.

Anisometropia of marked degree or defective vision in one eye more than the other may cause exophoria. It is not with exophoria of these types that one is concerned, since the treatment is obvious. In addition

to the removal of the cause, convergence exercises are often indicated and are of distinct value. After one corrects the cause and has the patient do converging exercises, the symptoms may be relieved, and yet the exophoria and adduction may remain the same.

In certain cases there will be an exophoria of approximately 10 prism degrees for distant and 15 for near vision with an adductive power of, say, 15 to 20 degrees. One corrects constitutional cases, faulty habits and the refraction, and then has the patients do converging exercises. The symptoms may be relieved, but the exophoria and adductive power remains of the same degree. The explanation of the relief of symptoms, aside from the mental effect, is not clear. Whatever the explanation may be, if the patient secures permanent relief he is satisfied, even though the surgeon may not be. Owing to certain charlatans, the effect of exercises of the ocular muscles at this time is held in mystic esteem by the laity.

There are not infrequently seen persons with exophoria but without symptoms, in whom the condition is discovered in the usual refraction. One had best ignore such forms of exophoria, since it would not be wise to bring the condition into the consciousness of the patient when there are no symptoms. Such persons can be kept under observation, and from time to time the muscles can be examined. It will be found that the degree of exophoria and the subnormal adduction remain approximately the same. From a practical standpoint, one cannot see the advantage of treatment. If the condition is symptomless, it is obviously unwise to attract attention to the exophoria.

The symptoms of the essential exophoria, an exophoria which remains uninfluenced under muscle exercises and other indicated treatment, may be extremely annoying or incapacitating to such a degree that the patient is materially handicapped in his work. In carefully studied and carefully selected cases, one should not hesitate to operate, since the relief is immediate and permanent. One would, of course, exhaust all other sources of treatment before recommending operation.

It would appear there are not two forms to deal with, as in esotropia, i. e., the hypertensive form and the form which is due to divergence insufficiency, but that in exophoria it is always the convergence that is at fault. Theoretically, there may be an exophoria due to divergence excess or to a hypertension of the abductors, but in practice this does not seem to obtain. I do not remember seeing a case of exophoria with a purely divergence excess.

To tenotomize or perform a recession on a lateral rectus is usually barren of results. It has been my experience with those persons with exophoria who require operation that only a shortening or advancement of the median rectus muscle is of value. In high degrees of exotropia

or divergent squint, a shortening, advancement, or both, of the median rectus muscle with a recession of the lateral rectus muscle is necessary. It is more difficult to correct a divergence, whether it is a squint or a phoria, than an esophoria or convergent squint. Hence one desires to overcorrect an exophoria or exotropia.

There is a strong tendency for an exophoria to recur. Whether this be due to the tension on the sutures or to other reasons, one cannot be sure. It is certain that results of shortening operations are more uncertain and difficult to estimate than those of recession. In the latter, results improve as time goes on, whereas in the former immediate results are apt to be better than the later ones. The reaction following the shortening operations is more severe; the hospitalization and bandaging are more prolonged, and the recovery of the normal appearance of the eye is longer delayed. Indeed, in recession the reaction is almost nil, and the normal appearance of the eye is restored in a few days. When one considers the disturbance of the muscle coverings and the sutures under tension in the shortening operations, the delayed recovery is not difficult to understand.

The choice of shortening operations on the median rectus muscle is left largely to the individual desire of the operator. In those cases of exophoria which have been designated essential exophoria, in which the patient is beyond adolescence and in which there are severe symptoms, brilliant results may be obtained by intelligent, careful surgical operation.

By essential exophoria, one means an imbalance that is not due to constitutional causes, refractive error or anatomic abnormality. It is usually combined with subnormal adduction, excessive or normal abduction and an abnormally distant near point of convergence.

One notices that in the correction of hypermetropia an exophoria is frequently made worse. Moderate overcorrection of myopia and undercorrection of hypermetropia may be desirable as temporary measures.

One observes that by means other than surgical intervention exophoria may be corrected, but that in many instances the condition tends to return and plague the patient throughout life. While one should not be overenthusiastic over surgical treatment of muscular errors, one should recognize that there are certain cases in which cure cannot be obtained otherwise. The importance of the matter is to recognize those cases in which surgical measures are required for permanent cure and not to operate indiscriminately. One should not be wedded to one operation or one procedure. The cases should be most carefully studied, and when operation is deemed necessary that procedure should be adopted which best suits the individual case.

OSMOTIC EQUILIBRIUM BETWEEN BLOOD AND INTRA-OCULAR FLUID AS INFLUENCED BY ANISOTONIC INJECTIONS

CLINICAL SIGNIFICANCE

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A survey of the knowledge concerning the nature of the intra-ocular fluid reveals a fairly complete acquaintance with the inorganic and organic constituents of the aqueous humor but a rather incomplete understanding of the physical forces involved in the maintenance of the physicochemical relationship between the intra-ocular fluid and its source—the blood. A contribution concerning the measurement of one of the several forces may aid in a better interpretation of the formation and utilization of the intra-ocular fluid. Hitherto the osmotic pressure of the aqueous humor has been measured on pooled fluids or indirectly. Recently, we [1] found it possible to measure the osmotic pressure of the aqueous humor and blood in animals by a method introduced by Hill.[2] This procedure made it possible to study the osmotic changes produced in the intra-ocular fluid by the introduction of anisotonic solutions into the blood stream.

Previous investigations on the influence of intravenous injections of hypertonic fluid on the intra-ocular pressure led several investigators to advise the use of this procedure for the lowering of intra-ocular tension in glaucoma. Definite variations in intra-ocular tension have been produced experimentally in animals by von Ruben,[3] Weekers,[4] Hertle [5] and Duke-Elder [6] and in man by Hertle,[7] Duke-Elder [8] and

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1. Gilman, A., and Yudkin, A. M.: Am. J. Physiol. **104**:235, 1933.
2. Hill, A. V.: Proc. Roy. Soc., London, s. A. **127**:9, 1930.
3. von Ruben, L.: Arch. f. Ophth. **86**:258, 1913.
4. Weekers, L.: Arch. d'opht. **41**:65, 1924.
5. Hertle, E.: Arch. f. Ophth. **88**:197, 1914.
6. Duke-Elder, W. S.: Brit. J. Ophth. **10**:1, 1926.
7. Hertle, E.: Arch. f. Ophth. **90**:309, 1915.
8. Duke-Elder, W. S.: Brit. J. Ophth. **10**:30, 1926.

Lambert [9] by intravenous and oral administration of anisotonic fluids. In the aforementioned experiments the osmotic pressure of the intra-ocular fluids was not measured. We therefore produced variations in the blood stream of a group of animals by the intravenous injection and oral administration of anisotonic fluids, and recorded the subsequent relation between the osmotic pressures of the blood and of the intra-ocular fluid.

EXPERIMENTAL PROCEDURE

Twenty-seven healthy stock dogs of various ages were used in this investigation. The eyes were examined carefully and were found to be normal. After the animal was placed on an operating table, the corneas of both eyes were anesthetized with a 3 per cent solution of cocaine. When the anesthesia was complete, the intra-ocular fluid was removed from the anterior chamber of the right eye by means of a 1 cc. standard Luer syringe. Blood was removed simultaneously from the femoral artery and placed in a flask with beads. The contents of the flask were then gently whipped to prevent coagulation. The defibrinated whole blood was used for the determination of osmotic pressure. Any error due to the escape of carbon dioxide from the blood was avoided by exposing the blood during the determination of a mixture of 5 per cent carbon dioxide and 95 per cent oxygen gas. Determinations of the osmotic pressure of the fluids under examination were made immediately after they were obtained. The instrument used was that developed by Hill [2] and described in detail by Margaria.[10]

The essential apparatus for this procedure consists of a symmetrical two-faced thermopile enclosed in an air-tight chamber. Absorbent papers are moistened with two fluids, one of known and the other of unknown vapor pressure. They are then placed on the two surfaces of the instrument. A temperature gradient between the two surfaces is produced by the different rate of evaporation from the condensation on the surfaces of the two fluids. The greater the difference between the osmotic pressure of the known and the unknown fluids being tested, the greater will be the difference in the temperature gradient between the two surfaces of the thermopile, which results in the production by the instrument of an electromotive force proportional to the difference in temperature of the two sides. This electromotive force is measured by means of a sensitive galvanometer. Thus, the electromotive force developed is directly related to, and can be used to measure accurately, the osmotic pressure of the fluid being tested.

NORMAL OSMOTIC PRESSURE OF THE AQUEOUS HUMOR AND OF THE BLOOD

Table 1 gives the comparisons of the osmotic pressure of the blood and of the aqueous humor. The osmotic pressure is expressed in per cent of concentration of an osmotically equivalent solution of sodium chloride.

From this table it will be noted that the average deviation between the osmotic pressure of the blood and of the aqueous humor was

9. Lambert, R. K., and Wolf, J.: The Systemic Use of Hypertonic Solution in Glaucoma, Arch. Ophth. **2**:198 (Aug.) 1929.

10. Margaria, R.: J. Physiol. **70**:417, 1930.

equivalent to a difference represented by the osmotic pressure of 0.012 per cent solution of sodium chloride. The standard deviation for the apparatus was calculated as 0.018 per cent. The average osmotic pressure of all the samples of blood examined was equivalent to that of 0.926 per cent solution of sodium chloride as compared with an average figure of 0.924 for the aqueous humor. Such a difference between the osmotic pressure of the circulating fluid—the blood—and that of the aqueous humor indicates the existence of an equilibrium between the fluids.

TABLE 1.—*Comparison of Osmotic Pressure of the Blood and of the Aqueous Humor*

Sex	Aqueous, per Cent of Sodium Chloride	Blood, per Cent of Sodium Chloride	Difference: Blood Hypertonic, per Cent of Sodium Chloride	Difference: Aqueous Hypertonic, per Cent of Sodium Chloride
F	0.914	0.915	0.001	.....
F	0.929	0.915	.....	0.014
F	0.927	0.946	0.019	.....
F	0.912	0.917	0.005	.....
M	0.936	0.941	0.005	.....
F	0.915	0.927	0.012	.....
M	0.934	0.955	0.021	.....
F	0.893	0.915	0.022	.....
F	0.926	0.915	.....	0.011
F	0.922	0.907	.....	0.015
F	0.907	0.923	0.016	.....
F	0.917	0.922	0.005	.....
F	0.931	0.941	0.010	.....
F	0.939	0.933	.....	0.006
M	0.923	0.931	0.008	.....
M	0.930	0.950	0.020	.....
M	0.926	0.945	.....	0.019
M	0.921	0.925	0.004	.....
F	0.927	0.936	0.009	.....
M	0.946	0.944	.....	0.002
F	0.940	0.901	.....	0.039
M	0.950	0.929	.....	0.021
M	0.918	0.908	.....	0.010
F	0.938	0.936	.....	0.002
F	0.895	0.887	.....	0.008
F	0.947	0.928	.....	0.019
M	0.902	0.909	0.007	.....

With this finding as a background, further investigation was made to determine the osmotic changes produced in the blood and in the aqueous humor by the intravenous injection of a 10 per cent solution of sodium chloride.

A group of five animals was used for this experiment. Amytal was given intraperitoneally for anesthetization. When the animal was properly under the influence of the anesthetic, a sample of blood was taken from the femoral artery. The plan for our experiment demanded two subsequent samples of aqueous humor. It has been shown by one of us (Dr. Yudkin [11]) that the removal of fluid from the anterior chamber of the eye produces a pathologic condition resulting in the reformation of fluid of a changed chemical composition. Therefore,

11. Yudkin, A. M.: Aqueous Humor: Critical and Experimental Study, J. A. M. A. **87**:1910 (Dec. 4) 1926.

no sample of aqueous was taken with the original sample of blood. Reference to table 1 shows that blood and aqueous humor are practically isotonic. Therefore, it was assumed that the original osmotic pressure of the aqueous humor, before the initiation of the experimental procedure, was essentially the same as that of the blood.

Immediately after the original sample of blood was drawn, 5 cc. of a 10 per cent solution of sodium chloride per kilogram of body weight

TABLE 2.—*Osmotic Changes in the Blood and in the Aqueous Humor After Intravenous Administration of Hypertonic and Hypotonic Solutions* *

Experiment No.	Osmotic Pressure of Normal Blood	Osmotic Pressure of Blood After Injection of Sodium Chloride	Osmotic Pressure of Aqueous Humor After Injection of Sodium Chloride
1	0.910	0.985	0.954
2	0.907	1.020	0.998
3	0.931	1.024	1.030
4	0.914	0.945	0.976
5	0.898	0.968	0.944
		After Injection of Water	After Injection of Water
1		0.847	0.908
2		0.829	0.934
3		0.851	0.897
4		0.905	0.904
5		0.855	0.895

* Osmotic pressure is expressed as per cent of concentration of an osmotically equivalent solution of sodium chloride.

TABLE 3.—*Osmotic Changes in the Blood and in the Aqueous Humor After Administration Orally of Hypertonic and Hypotonic Solutions* *

Osmotic Pressure of Normal Blood	Osmotic Pressure of Blood After Administration of Sodium Chloride	Osmotic Pressure of Aqueous Humor After Administration of Sodium Chloride	Osmotic Pressure of Blood After Administration of Water	Osmotic Pressure of Aqueous Humor After Administration of Water
0.928	1.018	1.023	.....	.....
0.909	0.955	0.945	.....	.....
0.901	.....	.....	0.834	0.873
0.929	.....	.....	0.848	0.892
0.908	.....	.....	0.839	0.860
0.936	.....	.....	0.887	0.890
0.887	.....	.....	0.811	0.845

* Osmotic pressure is expressed as per cent of concentration of an osmotic equivalent solution of sodium chloride.

was given intravenously. From previous experience, we allowed thirty minutes for equilibration to take place, after which a sample of blood from the femoral artery was drawn simultaneously with withdrawal of fluid from the anterior chamber of the eye. The osmotic changes in the blood and in the aqueous humor following the injection of a solution of sodium chloride are summarized in table 2.

From the results in this table it may be seen that thirty minutes after the injection of the hypertonic saline solution, physical chemical equilibrium has once more caused these fluids to become approximately

isotonic. The osmotic pressure of the aqueous humor is, however, slightly lower than that of the blood. A similar experiment was performed on two dogs without anesthesia. The hypertonic saline solution was administered by a stomach tube. Ninety minutes after the administration of fluid, samples of blood and of aqueous humor were taken. The results of these experiments appear in table 3. In each case there was a marked rise in the osmotic pressure of the blood which was accompanied by a similar increase in the osmotic pressure of the aqueous humor. The fluids are again practically isotonic.

OSMOTIC CHANGES IN THE AQUEOUS HUMOR FOLLOWING THE ADMINISTRATION OF HYPOTONIC SOLUTIONS

In this experiment two groups of animals were used. The original five that received saline solution intravenously were given 50 cc. of distilled water per kilogram of body weight by the intravenous route. The water was given over a period of ninety minutes to prevent too extensive hemolysis. Equilibration was then allowed to proceed for an additional thirty minutes, thus allowing readjustment of osmotic pressure to go on over a period of one hundred and twenty minutes. The results of this experiment are also summarized in table 2. It may be observed that there is a tendency for the osmotic pressure of the aqueous humor to change parallel with that of the blood. In the second part of the experiment distilled water was administered by a stomach tube to a group of five animals. No anesthetic was used in this experiment. The results of this experiment are summarized in table 3. Here again it is obvious that the osmotic pressure of the aqueous humor has a tendency to change parallel with that of the blood.

A review of the results obtained by these five experiments shows that the osmotic pressure of the blood and of the aqueous humor is altered by the introduction of anisotonic solutions into the blood stream. When a hypertonic solution is administered intravenously or by stomach tube, there is a resulting increase in the osmotic pressure of the aqueous humor which practically parallels that of the blood. At the end of thirty minutes, the two fluids are almost isotonic. The administration of a hypotonic solution—distilled water—intravenously or by stomach tube produces a diminished osmotic pressure in the blood and in the aqueous humor. It is evident, however, that the osmotic pressure of the ocular fluid does not decrease as readily by the administration of hypotonic solutions as it increases when hypertonic solutions are used. It is obvious that the reduction of the osmotic pressure of the fluid in the anterior chamber of the eye is accomplished more slowly in the former, the end-result, after the administration of water, being an aqueous humor definitely hypertonic to the circulating fluid—blood.

COMMENT

The foregoing results, demonstrating complete equilibration within thirty minutes between aqueous humor and blood after the introduction of hypertonic solution into the blood, raise the question as to the value of this procedure for relief from increased intra-ocular pressure. We have shown that following intravenous injection of a 10 per cent solution of sodium chloride the osmotic pressure of the aqueous humor increases, owing to the passage of fluid from the anterior chamber into the blood stream, resulting in a decreased intra-ocular tension, as shown by Duke-Elder and others. However, references to the foregoing data demonstrate that the outward passage of fluid lasts no more than thirty minutes. Once osmotic equilibration is obtained, there are no forces acting to cause a further loss of fluid from the anterior chamber, even though a large quantity of the sodium chloride still remains in the circulating fluid. It is our opinion that in the normal state intra-ocular pressure depends on the balance between capillary hydrostatic pressure forcing fluid into the chamber and the osmotic pressure of the serum protein withdrawing fluid into the circulation. The initial effect of the introduction of a hypertonic (sodium chloride) solution in the blood stream, resulting in a circulating fluid having an osmotic pressure greater than that of the aqueous humor, would be to enhance the attracting force of the serum protein, with the resulting loss of fluid from the anterior chamber. However, this difference in osmotic pressure due to the increased concentration of electrolyte rapidly disappears, as previously mentioned. Once these fluids are again osmotically equilibrated, the relative hydrostatic pressure effecting the entrance of fluid and osmotic pressure of the serum protein effecting the exit of the fluid, which were the original forces in the establishment of the intra-ocular tension, again bear their same relationship. This would allow the pressure in the anterior chamber to return to its original level. Meanwhile, other factors are operating. The introduction of a hypertonic saline solution into the blood stream will cause a mobilization of fluid from the cells and interstitial spaces, thus greatly increasing the blood volume. This would manifest itself in increased blood pressure and increased hydrostatic pressure in the capillaries, resulting in forces tending to cause the entrance of more fluid into the anterior chamber than was originally present. The foregoing result has been shown experimentally by Troncoso.[12] Moreover, the increase of blood volume causes a dilution in the concentration of the blood protein; thus the rate of exit of fluid from the anterior chamber of the eye due to the osmotic force of the serum protein is diminished, constituting still another factor tending to raise intra-ocular pressure above its original level.

12. Troncoso, V.: Clin. ophth. **7**:20, 1901.

Finally, as the kidneys excrete the excess salt that has been administered, the osmotic pressure of the blood will tend to be lower than that of the aqueous humor, reversing the relation which was originally present when the hypertonic solution was introduced, and thus facilitating the entrance of more fluid into the anterior chamber. In view of the foregoing facts, whereas the intravenous administration of hypertonic sodium chloride might be effective in producing a lowering of the tension for a short time, the majority of the forces would, in our opinion, aggravate the condition originally present. Similar findings have been recorded by Jackson [13] from observations on the effect of injection of a hypertonic solution on the pressure of cerebrospinal fluid, the formation and reabsorption of which is somewhat similar to the aqueous humor. We are aware, however, that with the eventual renal excretion of all the injected sodium chloride, a general systemic dehydration results. That such a general reaction may involve withdrawal of fluid from the anterior chamber cannot be denied. However, the forces acting before this end-result is obtained and the general subjective discomforts which accompany marked body dehydration are factors which must be evaluated before such a radical procedure as the injection of hypertonic solution of sodium chloride to reduce intra-ocular tension is initiated.

CONCLUSIONS

In the dog, arterial blood and aqueous humor were found to be isotonic. The introduction of hypertonic and hypotonic solutions into the blood produced changes in the osmotic pressure of the aqueous humor parallel to those observed in the blood. The osmotic equilibration between the blood and the aqueous humor proceeded with greater facility when the blood was hypertonic to the aqueous than when the opposite condition was affected. Owing to the rapidity of osmotic equilibration between the aqueous humor and the circulating fluid, and in light of certain theoretical considerations, the therapeutic value of injections of hypertonic solution for the relief of intra-ocular tension is questioned.

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13. Jackson, H.; Kutsunal, T.; Leader, L. O., and Joseph, L. D.: Effect of Hypertonic Dextrose Solutions on Intracranial Pressure, J. A. M. A. **100**:731 (March 11) 1933.

COMPARISON OF OPERATIONS FOR CHRONIC GLAUCOMA

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In taking up this subject I shall mention only those operations which have for their object the obtaining of a good filtering cicatrix, and in doing so I shall confine myself to five: trephining, the Lagrange operation, iridotasis, iridencleisis and the special combination of the Lagrange operation and iridencleisis which I now use most frequently. During the past few years I have several times described the latter operation and spoken of the good results obtained, but I have always stated that for certain types of glaucoma I was still employing the Elliot trephine. For several patients I have used trephining for one eye and iridencleisis-sclerectomy for the other, so as to compare the results both as to the effect of the operation on the glaucomatous eye and as to the effect on the patient. Every operation performed for chronic glaucoma has some drawbacks, and it will probably be many years before one is able to evaluate the final results.

I cannot do better at this point than to quote from a recent article by Harrison Butler.[1] In the opening paragraph of his article, he said:

> At the first meeting of the Society that was held in Coventry, in June, 1926, I read a paper on iridencleisis and showed some cases upon whom the operation had been performed. At that time I had performed 15 operations only, and the paper was of a preliminary character. When the paper came to me for proof correction I added a footnote stating that I had given up the operation as ineffective. I returned to trephining for a time, but one or two rather tragic results made me feel that I must give iridencleisis another trial. My determination was strengthened by a conversation with Dr. Harald G. A. Gjessing, of Drammen, Norway. He pointed out that I had been too precipitate in relinquishing the operation because some of the eyes did not at once, or within a limited time, show the desired fall in tension, and that probably most of the cases that I had trephined after iridencleisis would have been ultimately successful without further operation. His experience was that occasionally the full effect was shown only after a month or more, and that during this period of convalescence it was necessary to employ pilocarpine, and daily massage of the globe. Subsequent experience has shown that this is true.

In regard to iridencleisis, Butler gave the statistics of other operators: Wilmer had 87.4 per cent of successes in 517 operations, and

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1. Butler, T. Harrison: Iridencleisis and Trap-Door Iridectomy in the Treatment of Glaucoma, Brit. J. Ophth. **16**:741 (Dec.) 1932.

Gjessing had 83.5 per cent of successes in 122 operations. Gjessing gives no case of late infection and Wilmer 0.38 per cent of late infection. Butler's statistics, however, were based only on 60 iridencleises, and he stated that his statistics favor that operation. He stated that he reserved some of the worst examples of glaucoma for trephining, and also that in trephining he used a 2 mm. trephine in place of the 1.5 mm. trephine that I always use. Butler had 90 per cent of successes following trephining. He also called attention to the fact that Wilmer had 88 per cent of successes following trephining, and another surgeon, 92.8 per cent. So when he gave his opinion that iridencleisis gives a better percentage of success than trephining, it was based on his own statistics in a really small number of cases.

In citing the disadvantages of trephining, Butler considered it a more serious insult to the eye. This may be true when a 2 mm. trephine is used and the worst cases of glaucoma are selected for the operation. I think he is correct in saying that there is apt to be a larger bleb following trephining than following iridencleisis. In past years late infection was undoubtedly more common after trephining than after iridencleisis. There is also more danger of hypotonia after trephining than after iridencleisis, especially with the 2 mm. trephine. I believe that Butler's statistics and deductions would have been somewhat different had he used iridencleisis and trephining in a larger number of cases, and had he not selected most of the worst cases for trephining. My belief has been for many years that iridencleisis-sclerectomy is preferable in cases of congestive glaucoma with fairly high tension, and that trephining is better for simple noncongestive glaucoma, especially with low tension. I shall consider this point a little more in detail later in this communication.

Butler stated the following: "The only real objection to iridencleisis is that its effect is apt to be slow, and that if the after-care is not carried out conscientiously the filtration may become ineffective." I have recently heard of another objection in a personal report to me of a case of iridocyclitis in the eye operated on which caused a sympathetic appearance of the condition in the other eye and the loss of both eyes.

From a perusal of Butler's article, it is easy to see that his operation of choice for chronic glaucoma is simple iridencleisis performed exactly as recommended by the late Harold Gifford. This operation, however, requires, in practically every case, a fairly prolonged period of careful massage and the use of pilocarpine in order to establish a filtering cicatrix. As a rule, I have found massage unnecessary when both iridencleisis and a small Lagrange sclerectomy have been performed. In carrying out this combined operation, it is necessary to punch out with the punch or cut away with the scissors only a small por-

tion of the lip of the sclera extending above the conjunctival flap, which has been pulled forward. This procedure insures that the pulled-up tongue of the iris will not be too tightly held down by the scleral lip and allows a freer flow of aqueous. This provides the good result desired and makes unnecessary the prolonged massage which Butler's article indicates as necessary in simple iridencleisis.

In regard to the straight Lagrange operation, in 1910 I [2] published a résumé of the various attempts to form a filtering cicatrix by various operators, including Holth, Herbert and Lagrange. This was two years after John E. Weeks had presented his four preliminary cases. My first Lagrange operation was performed in September, 1907, and represented one of the earliest operations performed in this section. The patient, aged 23, had a case of juvenile glaucoma; my latest knowledge of this patient was that he was still working with good vision up to a year ago. At the time of publishing the paper I had performed six Lagrange operations, and all of them gave excellent and successful results. At that time I stated the following conclusion:

> I feel reasonably sure that the Lagrange operation, or one of its modifications, has come to stay because it is a distinct advance in our operative treatment of chronic glaucoma, in that it makes the effect of an iridectomy more marked at first, and more permanent later, thus keeping the vision existing at the time of operation much longer than can be hoped for from miotics, simple iridectomy, sclerotomy or cyclodialysis.

Since my adoption of iridencleisis-sclerectomy I have performed no straight Lagrange operations. I have performed a few modified Lagrange operations in which the conjunctival flap is made prior to the incision. In a few cases in which iridencleisis was started, a friable iris became injured to such an extent that it was thought best to change the procedure into a modified Lagrange operation.

I continued to perform the Lagrange operation until Colonel Elliot visited this country, and then I abandoned it for trephining. I used trephining for a considerable period until I unfortunately had a patient in whom infection developed six months after the operation, and the eye was lost because of panophthalmia. In another case seen at about that time, severe iridocyclitis developed, and while the patient had some vision left, it was not a successful result. I then again used the Lagrange operation, modified as mentioned by first laying down a conjunctival flap. I next decided to try Borthen's operation, which had been so well spoken of by Dr. David Harrower. This operation gave good results until I had two patients who failed to get a filtering cicatrix and relief from the glaucoma owing to a rolling up of the pulled-out

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2. Greenwood, Allen: The Filtering Cicatrix for Chronic Glaucoma, J. A. M. A. **55**:190 (July 16) 1910.

iris. This rolling up of the iris made a large cystic scar but not a filtering one, in that the rolled-up iris tissue prevented the aqueous from getting under the conjunctiva where it could be absorbed. These cases required a second operation in the nature of a sclerotomy and incision through the prolapsed iris.

During the past ten years, I have confined my operative work for chronic glaucoma almost entirely to trephining and iridencleisis-sclerectomy, and the results have been extremely gratifying except in one or two cases. None of the trephinings has resulted badly, but as I have reserved for this operation patients with noncongestive glaucoma with low tension, the good results are not surprising. I have performed iridencleisis-sclerectomy in the more serious cases, which include those showing a congestive type of chronic glaucoma, usually of long standing. In one case, the history of which will be given later, an eye was lost because of an expulsive hemorrhage, and in two other cases the operation was not successful in that other operations had to be performed, and even then no permanent reduction of tension was obtained and the visual results were poor. In one case the early formation of a cataract following the operation required removal of the cataractous lens, with only a moderate amount of restoration of vision.

I have had too few cases to give any statistics. With two eyes eventually lost following trephining and four eyes with poor results from iridencleisis-sclerectomy, I should say from my experience that the successful results for the two operations are about equally divided. In fact, lately the good results from a careful selection of cases for trephining favor that operation. However, when one takes into account the fact that some of the iridencleisis-sclerectomies were performed in less favorable cases, one would be justified in concluding that in favorable cases the results are likely to be good with either operation. Therefore, an operator who has perfected himself and has become extremely skilful in using a trephine is eminently safe. Also, the operator who perfects himself in carrying out a well performed iridencleisis with a small sclerectomy is also fairly sure of a safe operation for all cases.

If the ophthalmic surgeon desires to have several operations from which to choose, the two I have stressed here would offer him procedures to fit most of his cases of chronic glaucoma. I shall not give a lengthy description of the two operations, but shall simply point to some of the details which help to make for success.

In trephining less traumatism results when the smaller trephine is used and if the trephine is very sharp. I think that it is a mistake to split the corneal layers too far forward, as this adds to the trauma. The angle of the anterior chamber is farther back than it appears to be, so that splitting the layers only far enough forward to get the base

of the conjunctival flap out of the way of the trephine and to insure that at least part of the trephine hole is in the anterior chamber, without going through iris tissue that is adherent to the cornea, is enough. If trephining is kept for the noncongestive type of glaucoma, there is usually plenty of room for the whole of the opening to be in the anterior chamber, which is usually fairly deep, with almost no actual splitting of the corneal layers. The peripheral iridectomy should be large enough so that no iris tissue can prolapse into the trephine opening, and if there is any nuclear cloud in the lens, a full iridectomy is advisable. Filling of the anterior chamber with blood owing to cutting of the vessels at the root of the iris is apt to be less if the operation is used for noncongestive cases. Cutting the iris at its root in trephining causes more hemorrhage, and recurrent hemorrhages, than the snip of the sphincter used in iridencleisis.

In iridencleisis to which a sclerectomy is added, the opening should not be too far back in the sclera. If a keratome is used to make the conjunctival flap and the scleral incision, the point of entry must be carefully chosen, and unusual care must be taken to avoid injury to the lens. The iris must be carefully handled and not dragged out too forcibly. The sphincter should be incised near where the forceps grasps the iris on one side or on both sides. The advantage of snipping the sphincter on both sides is that a fine narrow coloboma results. The tongue of iris should be left with the black under-surface uppermost, but very little stroking should be permitted as this may rub off some of the easily detached pigment layer. For the sclerectomy a Lagrange punch is my preference, though many prefer the curved scissors. I have made it a rule, when a congestive glaucoma has had periods of very high tension, to make only a small scleral break, and for lower tensions to make a somewhat larger one, for the higher the tension the less difficult it is to obtain a filtering cicatrix. If the Graefe knife is used, the incision is greatly helped by the external rectus stitch with which the assistant steadies the eye and keeps it from rolling with the thrust of the knife.

Since I began to operate for chronic glaucoma I have performed several hundred of the different types of operations, with probably nearly twice as many iridencleises combined with sclerectomy as any of the others. Owing to the fact that all of my records are not now available to me, I cannot, as I have said, give any statistics. I can, however, record my failures. With trephining I have had the two dismal failures mentioned; with iridotasis, the two mentioned, and with the Lagrange operation, three partial failures in which vision was not entirely lost. In two cases in which the Lagrange operation was performed an additional operation (trephining) was necessary before the tension was finally reduced sufficiently. One eye was lost because of

iridocyclitis, which developed several months after an early successful result. With the modified Lagrange operation there were no complete failures. With my favorite operation of combined iridencleisis and sclerectomy I have had several poor results. These were all in cases of long standing and usually with high tension, and the patients were poor risks. One eye required enucleation following an expulsive hemorrhage. In one patient a cataract developed a few days after operation, during which the incision was made much too far back. In two cases the tension was not reduced and extra operations were required; one was successful and one was not. In the latter case the extra operation was performed by a colleague, who also operated on the remaining eye with a poor result. In one other case a good result was spoiled by a large vitreous hemorrhage which occurred a few days after operation. Among all of my cases I have had, fortunately, not one in which the operations on both eyes were failures.

Butler's measure of success is high; there must be a reduction in the tension to normal and a retention of all the visual acuity noted prior to operation. This measure of success is proper for the early results, but he who expects this degree of success to be maintained throughout the remaining life of the patient will be somewhat disappointed, for advancing years take their toll as in other conditions, a moderate lessening in the visual acuity being the rule five or ten years after operation.

In my operations for the past year, numbering eighteen, the results have been nearly 100 per cent successes. What they will be in the year to come cannot now be foretold. Although statistics are not possible, I can give some definite conclusions. First, and most important, is that from a study of all of my cases of glaucoma, operative and nonoperative, I am sure that the earlier the operation is performed, the better the result. In young and middle-aged patients, operative intervention is imperative. In old and very aged patients, miotics may be sufficient, it being borne in mind that age is no contraindication to operation. No one would think of operating on the very feeble and aged patient, especially if there was any advanced cardiovascular and renal disease. I have never regretted an operation performed in the very early stage of glaucoma, but have many regrets following too long attempts to save the patient's vision with miotics. A patient treated with miotics must be kept under close observation, and if this is not possible, operation must replace medical treatment.

Dr. Maud Carvill,[3] in her recent review of the cases of patients with glaucoma who were admitted to the Massachusetts Eye and Ear

3. Carvill, Maud: A Review of the Cases of Glaucoma Admitted to the Massachusetts Eye and Ear Infirmary Over a Period of Two Years, Tr. Am. Ophth. Soc. **30**:71, 1932.

Infirmary over a period of two years, gave a table of the results of the various operations performed at the Eye and Ear Infirmary; the percentage of favorable results was about the same for iridotasis, the Elliot trephining and what Dr. Carvill describes as a Lagrange-tasis, which is the operation I have described under the name of iridencleisis-sclerectomy. Her favorable results compare closely with those which I have outlined.

The following cases will illustrate some of the conditions mentioned.

REPORT OF CASES

CASE 1.—Mrs. H. M., aged 67, was first seen in September, 1932. Vision was markedly reduced in the left eye and moderately so in the right, with a general contraction of the fields, entire loss of the nasal field in the right eye and considerable loss of the nasal field in the left eye. As it was found in May, 1923, that pilocarpine was not preventing an increase in the glaucoma, a double iridencleisis-sclerectomy was performed, vision in the right eye being 20/40 and that in the left eye, 20/70. The operation was successful in reducing the tension in both eyes, and in June, vision in the right eye was 20/30. In 1926, vision in the right eye had decreased to 20/50, where it remained, there being a slight clouding in the nucleus of the lens. In both eyes the tension has been low since the operation, and for the nearly eleven years after the operation the eyes have remained in good condition.

CASE 2.—Mr. M. H., aged 57, was first seen on June 7, 1920, with simple chronic glaucoma. Vision in the left eye was poor, and that in the right eye was 20/30. The field of vision began to grow narrow in 1921, and the tension increased to 45 mm. in each eye. A double iridencleisis-sclerectomy was performed with good results, and two years later vision in the good eye was 20/20. In June, 1929, vision was 20/30, and two years later it had decreased to 20/40. When the patient was last seen vision in the good eye was 20/30+, there was a good filtrating cicatrix, and the eye had a low tension.

These two cases in which early iridencleisis-sclerectomy was performed are detailed to show that even after ten and twelve years good sight has been retained.

CASE 3.—Mrs. H. L., aged 62, was seen on May 3, 1926, with vision of 20/20 in the right eye and of 20/30 in the left eye. She stated that there had been a hemorrhage in the left eye recently which interfered with vision. The left eye showed a cupped disk and a slight loss in the upper nasal field. The tension was 28 mm. Pilocarpine was ordered. On October 22 and November 1, vision was 20/15 in each eye. Both eyes showed marked arteriosclerosis, and the patient had a blood pressure of 225. She was seen in January and April, 1927, when she was still using pilocarpine in the left eye, and the vision was normal. In February, 1928, vision was 20/15 in both eyes, but the left eye showed a slight loss in the upper nasal field and the tension was 45 mm. Pilocarpine in increased strength and frequency was ordered. In January, 1929, vision had decreased to 20/70 and the tension had increased to 50 mm.; operation was advised in spite of the extremely high blood pressure and the arteriosclerosis. Iridencleisis-sclerectomy was performed, and in March, vision had increased to 20/40. There was a good bleb, and the eye was soft. The patient has been

repeatedly seen since then, and there has been no increase in tension or disturbance in the left eye, and vision has remained at 20/40.

CASE 4.—Miss L. G., aged 76, was first seen on May 3, 1932, complaining of failing vision which was found to be due to chronic glaucoma with cupped disks; the tension was 32 mm. in the right eye and 36 mm. in the left eye; the blind spot was slightly enlarged, especially in the left eye, which also had a slight loss of nasal field. With the use of pilocarpine there was some improvement, which continued throughout the summer. In September vision in the right eye was 20/30+, and that in the left eye was 20/70+. The tension was 22 mm. in the right eye and 28 mm. in the left eye. In view of the fact that the tension was still a little high, it was decided to operate on both eyes, the left eye first. Iridencleisis-sclerectomy was performed on the left eye, and four days later trephining was carried out on the eye with the lower tension. Up to the present the results have been most gratifying. The patient has a good filtrating cicatrix in each eye. The right eye has a vision of 20/30, and in the left eye the vision has increased to 20/50+. Both eyes have a low tension, especially the right one, on which trephining was performed, but there is no hypotonia. No massage has been used in this case, and, as I have mentioned, it is seldom necessary with iridencleisis-sclerectomy.

CASE 5.—Miss H. B., aged 45, was first seen in 1900. For many years her glasses had been changed for presbyopia, until October, 1930, when vision in the right eye was reduced to 20/70, the nasal field was narrowed, the disk was cupped, and the tension was 26 mm. With the use of pilocarpine, vision was increased to 20/40 and the tension was reduced to 18 mm. This state was maintained until March, 1931, when it was found that the field of vision was growing a little narrower and vision had decreased to 20/50. The tension was 35 mm. Iridencleisis-sclerectomy was performed, and two months later vision in that eye was 20/50. In November, 1931, the patient returned with the statement that the left eye, which had never shown any signs of trouble, had been a little blurry. It was found that the tension of this eye was 43 mm. and vision, 20/20—. There was no apparent loss of field. On November 17, the tension had dropped to 22 mm. under pilocarpine, and vision was 20/20. From then on for a period of testing every two weeks the tension gradually decreased until it was 11 mm.; vision and the field were normal. In September, 1932, vision was still 20/20, but the tension had increased to 18 mm. The increased use of pilocarpine brought the tension to 14 mm., and on September 19, it was thought best to operate; a trephining was performed with a buttonhole iridectomy. At the present time vision in the right eye, which at one time had decreased to 20/50, is 20/30, and that in the left eye is 20/20. This patient stated emphatically that trephining caused much less discomfort and disturbance than did iridencleisis-sclerectomy on the other eye. The patient in case 4 also stated that she had much less discomfort after trephining than she did following iridencleisis-sclerectomy.

CASE 6.—Mr. E. W., aged 73, was seen on Jan. 29, 1929. His sight had been growing dim for some time. With a —10.00 sphere vision in the right eye was 20/50, and with a —9.00 sphere, vision in the left eye was 20/200—. In the left eye the disk was cupped, especially on the nasal side, causing a temporal field defect. The right eye showed no sign of glaucoma. The patient left Boston, and I did not see him again until Feb. 8, 1932, when the left eye showed a bullous keratitis, and nearly the whole of the temporal field and part of the upper field had been lost. The tension in the right eye was 26 mm. The tension in the left eye was not taken on account of the bullous keratitis. A month later, under pilocarpine, the tension in the right eye was 18 mm. The field was somewhat

enlarged, so that the patient could walk about. He was examined every few weeks, and in September the tension in the right eye was 17 mm., and that in the left eye was 30 mm., the bullous keratitis having disappeared. The fields were again a little more contracted. On December 3, the patient was sent to the hospital for trephining. The trephining of the right eye produced a very large coloboma, which was done especially because the center of the lens was cloudy. Since the operation the eyes have been soft, and the right eye, with the proper glass, has vision of 20/70+, and with a telescopic lens, a vision of 20/20. The tension, measured on Feb. 14, 1933, with the old Schiötz tonometer, was 6 mm. in each eye. Vision in the right eye was 20/50—, and that in the left eye was 20/100—, with an improvement in the temporal field of the right eye. Without his myopic glass the patient is able to read as much as he wishes.

In this case the vessels of the disk were crowded to the temporal side, allowing nasal cupping and a loss of the temporal field. This patient was seen in consultation by Dr. Walter B. Lancaster, who concurred in the diagnosis and the necessity for operation.

In considering patients with glaucoma of very low tension, one must always keep in mind the possibility that the case may come under the classification so ably presented by Dr. Arnold Knapp.[4]

Case 7.—Mrs. E. L., aged 49, was seen on April 29, 1930. She had had failing vision for a year. Vision in the right eye had been poor since childhood. The right eye in the temporal field had vision of moving fingers. The left eye, with a correcting lens, had vision of 20/40. Examination of the fundi showed a cupped disk in the left eye; the disk was cupped especially above. The visual field of the left eye was contracted down and in, with a nasal step nearly to the point of fixation. The tension, measured with the old Schiötz tonometer, was 60 mm. in the right eye and 50 mm. in the left eye. Immediate operation was advised. Iridencleisis-sclerectomy was performed on both eyes at the same time. On the afternoon of the operation, an expulsive hemorrhage occurred in the right eye. There was no disturbance in the left eye following the operation. There was a good bleb, and a year after the operation the tension in the left eye was 14 mm. as measured with the old Schiötz tonometer, and with a correcting lens vision was 20/30+.

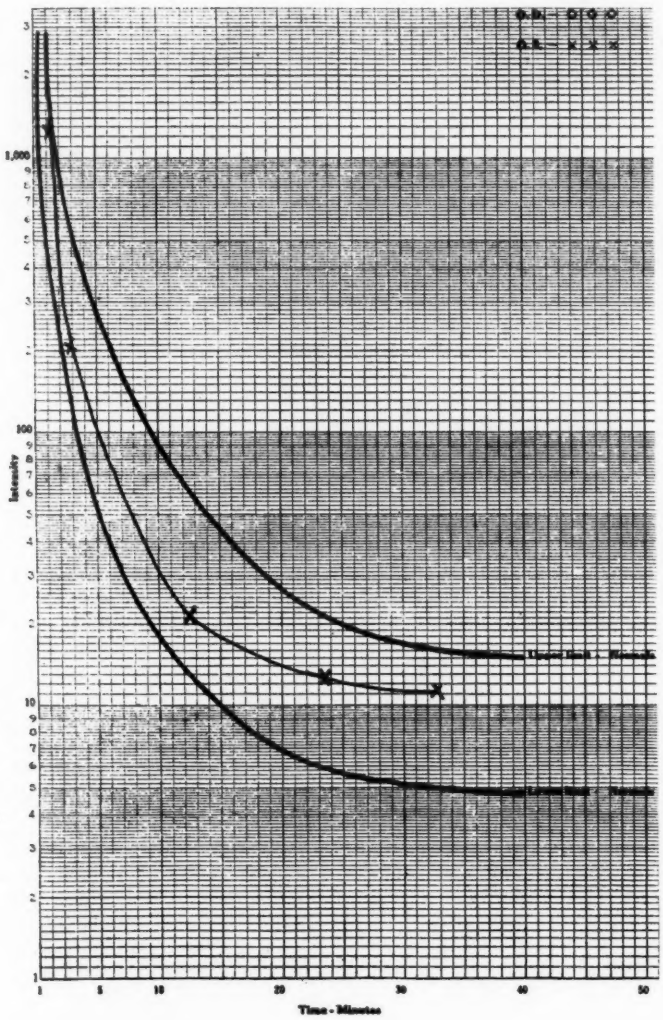
This case is reported as being the only one I have seen in which an expulsive hemorrhage occurred following any operation for chronic glaucoma.

I have found that when a single eye is affected it is helpful in watching the fellow eye to have a light threshold chart made from time to time. In some cases the chart has indicated the necessity for considering an early operation. In other cases the chart has not been so helpful. The following case is interesting in this connection.

Case 8.—Mrs. A. B. P., aged 48, was seen on Jan. 10, 1928, when she gave a history of not seeing well with the right eye for four years. Examination showed a vision in the temporal field of counting fingers at 3 feet. The disk

4. Knapp, Arnold: Association of Sclerosis of the Cerebral Basal Vessels with Optic Atrophy and Cupping, Arch. Ophth. **8**:637 (Nov.) 1932.

was deeply cupped, with an undermined edge all around, the only vision being in the center of the temporal field. The tension in the right eye, measured with the old Schiötz tonometer, was 65 mm. In the left eye vision was 20/15; the disk and field were normal, but the tension was 35 mm. Operation on the right eye was advised to save what little vision was left, and iridencleisis-sclerectomy



Light threshold chart taken on Nov. 7, 1928. The left eye was normal. There was no significant change from the previous test, made on Jan. 23, 1928.

was performed on January 19, with excellent results. On March 12, 1933, the condition was the same as that present prior to operation. On Jan. 23, 1928, while the patient was still in the hospital, a light threshold chart was made and reported as "very good normal."

On Nov. 7, 1928, the patient came in with the statement that after a period of unavoidable mental and nervous excitement she had been troubled by spells

of smoky vision. Vision was still 20/15; the disk and field were normal, and the tension was 35 mm. She was sent to Dr. Derby's clinic, and the light threshold chart shown here was returned. The tension and the attacks of smoky vision, however, indicated glaucoma, and pilocarpine was ordered, to be used twice a day. There were no further visual disturbances until Oct. 18, 1929, when following an automobile accident the smoky vision returned and persisted. Examination showed vision of 20/30; the tension was 60 mm.; the blind spot was twice the normal size, and there was a slight loss of the lower nasal fields. An immediate iridencleisis-sclerectomy was performed, with good results. On March 12, 1933, three and one-half years after operation, vision was 20/15, the tension was 16 mm., and there was a good filtering cicatrix.

ACUTE INFLAMMATIONS OF THE ORBIT IN CHILDREN

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The terms orbital abscess, orbital cellulitis, periostitis and osteomyelitis are used to denote the various types and also the various stages of acute inflammations of the walls and cellular contents of the eye socket. While these names mean much from the standpoint of surgical pathology, it is important that greater attention be paid to the etiologic factors of these inflammations if one is to have a thorough understanding of their various clinical courses and, consequently, be able to manage the treatment in an intelligent manner. Fuchs, in discussing inflammations of the orbit, stated that "treatment must, above all, have regard to the etiological factor." According to the experience of Birch-Hirschfeld, the causes may be listed as follows: (1) direct infection of the retrobulbar tissues from wounds, operations and foreign bodies, (2) inflammation from adjacent parts and (3) embolic conditions. His figures show that 60 per cent of cases of orbital cellulitis were due to sinus disease. He found the sinuses involved in 684 cases of inflammation of the orbit; the frontal sinus in 28.8 per cent, the antrum in 21.8 per cent, the ethmoid sinus in 20.5 per cent and the sphenoid sinus in 6.1 per cent. Several sinuses were affected in 14.7 per cent. These figures do not refer specially to children. He found that 11 per cent of cases of orbital periostitis occurred in the first decade of life, and that it was twice as frequent in the second and third decades. Vossius believes that it has a special predilection for children. Inflammation may spread to the orbit from adjacent tissues other than the accessory nasal sinuses, as in erysipelas or dacryocystitis. Green [1] reported a case following hordeolum. Phelps [2] described an abscess of the frontal lobe which ruptured into the orbit through the superior orbital fissure, burrowed under the periorbita and caused a discharging fistula at the external canthus.

From the Department of Ophthalmology, Children's Memorial Hospital.

Read before the Indianapolis Ophthalmological and Otolaryngological Society, May 11, 1933.

1. Green, John: Management of Orbital Infections, Am. J. Ophth. **14**:196 (March) 1931.

2. Phelps, K. A.: Cellulitis of Orbit in Infants and Children, With Report of Ten Cases, Ann. Otol., Rhin. & Laryng. **33**:1391 (Dec.) 1924.

Inflammation of tissues of the orbit secondary to osteomyelitis of the maxilla in infants deserves special mention and will be discussed at greater length later in this paper.

The embolic cases occur in any condition associated with bacteremia, such as scarlet fever, meningitis and influenza, but are relatively infrequent, judging by the reports in ophthalmic literature.

Radical surgical intervention is the usual treatment in the more severe cases of orbital inflammation. An incision is made as early as possible deep into the orbit where the abscess is thought to be, judging from the direction in which the eye is displaced, or into the periosteum if it appears to be the seat of inflammation. If pus has not yet formed and only blood escapes, that is considered beneficial, and a drain is inserted. Some operators prefer to make an incision similar to the Killian incision and search for pus along the orbital walls adjacent to the nasal sinuses. Others prefer to do an intranasal or external operation on the sinus when clinical and roentgen evidence indicates it. Such early and radical treatment seems necessary when one considers the possibility of serious complications, such as corneal ulceration (in 50 per cent of the cases, according to Schwendt), optic neuritis, thrombosis of the central vein of the retina, cavernous sinus thrombosis, meningitis and abscess of the brain. Birch-Hirschfeld found that 17 per cent of patients with cellulitis of the orbit died of meningitis, abscess of the brain or cavernous sinus thrombosis. Roemer stated that 20 per cent of cases of orbital cellulitis result in blindness of the affected eye, that 10 per cent of cases of periostitis of the wall of the orbit are fatal and that there is a mortality of 6 per cent in orbital inflammations due to ethmoiditis and of 15 per cent in those due to diseases of the antrum.

So far I have attempted to give a brief account of what one learns concerning the subject from standard texts and from the literature. During the past ten years I have had the opportunity to see, and in most instances to care for, about 25 children with orbital inflammations in private practice and at the Children's Memorial Hospital. I have had a growing conviction that there are important differences in the clinical course of orbital inflammations in children, as compared with adults, and also important differences in the proper treatment. These differences have to do with the small size, but active growth of the accessory nasal sinuses, with the developing tooth buds in the maxilla and with the tendency of children to get a blood stream infection from premature or even properly timed opening of an abscess in any location. Also, in children the tissues are softer and better nourished, pus can spread along fascial planes with greater ease, and the cornea is far more resistant to damage than in adults.

At birth the frontal sinuses are not developed, and do not become large enough to be a factor in orbital disease until about the seventh or eighth year. The ethmoid sinuses are present at birth as small spaces in soft, spongy, cancellous bone. The antrum also is present at birth and is relatively higher up and more medial than in later years. It lies practically below the ethmoid cells, and it is sometimes almost impossible in young children to differentiate between ethmoiditis and maxillary sinus infection by the direction in which the proptosed eye is displaced. The lamina papyracea is thin and is perforated by blood vessels and nerves, and occasionally there are actual dehiscences in it along the ethmomaxillary suture. The periorbita is somewhat loosely attached to the bone except at the sutures between the bones, and at these sutures it passes through to fuse with the periosteum on the other side. There is no proof that the lymphatics in the sinuses communicate with those of the orbit, but there is a definite communication between the ethmoid veins and the superior ophthalmic vein, occasionally with the inferior ophthalmic.

This intimate relation between the orbit and the ethmoid sinus, and to a lesser extent the antrum, explains the important part that infections of these sinuses play in inciting orbital disease. The majority of cases that I have seen are in this group. It is important to understand that there are all grades of severity even though the cause is the same. In the mildest cases one finds just a moderate redness and edema of the upper lid occurring a week or so after an infection of the upper respiratory tract has been established. Usually the swelling of the lid occurs suddenly. Almost always there is an obviously greater discharge from the nostril on the same side. This swelling of the lid, I believe, is due to blocking of the drainage of the superior ophthalmic vein into the ethmoid veins, owing to obstruction of the latter by pressure. Usually swelling of the lower lid follows a day or so later. Quite often this is as far as the process goes, after several days the swelling of the lid subsides from natural causes or from treatments consisting of hot or cold applications, the use of ephedrine, epinephrine and mild silver protein in the middle meatus and nasal suction. If the condition is more severe, the eyeball becomes proptosed and perhaps pushed toward the temporal side. Often the swelling of the lid becomes less when this occurs. Fixation of the globe may occur in the extreme cases, and is usually a sign that pus has formed. Chemosis of the bulbar conjunction is another sign that usually indicates the formation of pus. In these more severe cases it is important to make a careful examination of the reaction of the pupil to light and of the fundus, as optic neuritis may occur. Also, tests of the blindspot, visual fields and visual acuity should be made if the child is old enough. Moderate engorgement and tortuosity of the retinal veins may be seen but do not neces-

sarily have any serious importance. The cornea needs careful watching owing to the danger of abrasion and ulceration from exposure or from being rubbed by gauze dressings. An antiseptic ointment should be used liberally at this stage. Subcutaneous induration either just above or just below the internal canthal ligament is usually a sign of impending spontaneous rupture. In many cases it also indicates when and where to open the abscess. In some of the cases with these more severe manifestations the condition subsides when treated as I have described. Even in the cases in which incision and drainage are necessary recovery is usually rapid, so rapid that it does not seem possible that a real abscess in the cellular tissues of the orbit existed.

I believe that the process is really a subperiosteal abscess which pushes the periosteum away from the bone, causing the proptosis, and then slowly burrows forward and breaks out under the skin above or below the internal canthal ligament. Of course, it might extend backward toward the apex of the orbit and cause serious complications. I once made a postmortem dissection on a 2 year old child to determine how adherent the periorbita was over the area of the ethmoid sinus, and found it more adherent in the anterior part than in the posterior part. However, the fact is that no serious complications have occurred from extension backward, as far as I could tell. In several instances the abscess has pointed under the conjunctiva. This I regard as more serious, as it indicates a real involvement of the cellular tissues of the orbit, with more prolonged suppuration and greater danger to the extra-ocular muscles, optic nerves and ciliary nerves, with increased possibility of corneal damage.

The ideal treatment in cases of this type would be an intranasal operation on the ethmoid sinus which opens the diseased ethmoid cells, removes the diseased bone and evacuates the subperiosteal abscess. I know of a child for whom this was done. The result was truly remarkable. Pus poured out into the nose, and the proptosis subsided immediately. In another case the same result was obtained, but the child died of meningitis several days later. These are acute sinus infections and, I believe, radical intranasal surgical procedures should be avoided. The prevailing opinion of the pediatricians is that the treatment should be very conservative, and that most children get well without operation. The ophthalmologist and rhinologist, as a rule, see only the more severe cases and would probably wish to modify this statement and say that many of them get well without surgical intervention. The ophthalmologist, having in mind the danger of blindness, feels the urge to make an early and deep incision into the orbit; the rhinologist feels it wise to strike at the seat of the trouble and perform an external operation on the ethmoid sinus. The pediatrician, knowing how frequently children get metastatic septic foci from such procedures,

lends a wise word of restraint. Here, then, is an instance in which cooperation is valuable. My practice is to start at once with tampons of epinephrine or ephedrine and mild silver protein in the nose and nasal suction. Cold applications are used for the eye in the early cases and hot applications in the later stages. Careful examinations of the fundi are made daily, and of the vision and fields, if possible. If the abscess develops and points subcutaneously or subconjunctivally, it is opened by an incision with a Graefe knife, a grooved director is passed down toward the area of the ethmoid sinus, and the pus allowed to flow out. No pressure is made, and all manipulations are performed gently. If the pus flows out easily, no drain is used as this tends to increase the proptosis and increase fibrosis. In some cases, however, it is necessary to use a drain. The incision is reopened daily with the grooved director until drainage stops. If there is not a marked improvement both in the general condition of the child and in the proptosis, the rhinologist performs an external operation on the ethmoid sinus through an incision similar to that for an operation on the tear sac, and, perhaps, also makes a window resection into the antrum. Operation, including simple incision, is avoided, if possible, and when necessary it is done as late as possible to allow time for the abscess to be walled off and for the pus to become more liquid. This often means waiting anxiously for a week or more, which is very trying to all concerned, and yet I believe that it is the lesser of two evils. I have a greater fear of metastatic septic infections than I have of meningitis or cavernous sinus thrombosis, or even of the strictly ocular complications. In an early severe case with threatening complications, I should advise an incision through the skin, as for an operation on the tear sac, and elevation of the periosteum backward until pus is found. Care should be taken not to enter the cellular contents of the orbit, as to do so greatly endangers the eyeball. Incisions through the conjunctival fornix should be avoided, if possible, as drainage is not as good, and the use of gauze or gutta-percha drains is not satisfactory through such incisions.

I realize that this method of treatment may not appeal to a surgeon who feels obliged to do something immediately when confronted by a severe and potentially dangerous condition. Furthermore, I realize that good results can be obtained by more immediate and radical treatment. Phelps reported 10 cases of orbital inflammation in children in which he performed an external operation on the ethmoid sinus with good results in general, although in his series there were 2 cases of metastatic abscesses in other parts of the body, 2 cases of perforation of corneal ulcers and 1 death from an abscess of the frontal lobe. Some of these complications were present, however, before the operation was done, and cannot be ascribed to the operation. Also, his cases were all caused by the hemolytic streptococcus.

Acute periostitis and osteomyelitis of the rim or walls of the orbit may occur as a metastatic infection and have no relation to sinus infection. Three such cases are herein reported; 1 followed scarlet fever, 1 whooping cough and 1 opening and squeezing of an abscess of the breast in a new-born infant. In all 3 cases the abscess was located in the midline above. All ran a severe course; 2 showed marked proptosis, and in 1 case a large sequestrum of the roof of the orbit had to be removed, something which did not occur in any of the cases due to sinus disease. In these cases there is, of course, no possibility of spontaneous drainage by way of the nose. Incision and drainage are necessary, and I rather favor doing them early to prevent permanent destruction of bone and the disfiguring depressed scars which follow. But the danger of inciting or aggravating bacteremia must be considered in these cases also.

Osteomyelitis of the maxilla occurs more often in infants than in older children. In a few instances direct trauma to the cheek seems to be the exciting factor. More often it is due to trauma plus infection spreading upward from the gingival border in nursing infants. Clinically, there are marked induration and discoloration of the whole cheek and swelling of the lower lid more than of the upper. The eyeball is pushed forward and upward in about 10 per cent of the cases. The abscess may point anywhere along the lower lid, along the palate or in the canine fossa. Sequestration of bone or of the teeth is common. These abscesses are difficult to treat. Marx [3] reported a mortality of 25 per cent and advised very conservative treatment; he is opposed to incising the abscesses. Posey [4] reported several cases in which it was necessary to perform multiple operations consisting of incision, curettage and removal of sequestrated bone and teeth.

The following observation, while of no great importance, is of some interest. It has been my general impression that the left eye is affected more often than the right. In analyzing my case reports I find that this general impression is confirmed. In the whole series the right eye was involved in 9 cases and the left eye in 17. In the group due to disease of the ethmoid sinus there were 4 cases in which the right eye was involved and 11 in which the left eye was involved. Still [5] noted the same thing in regard to proptosis from subperiosteal hemorrhage in infantile scurvy. I know of no anatomic reason for this other than the difference in the origin of the common carotid artery on the two sides.

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REPORT OF CASES

Orbital Inflammation Due to Sinus Disease.—CASE 1.—G. G., aged 7 years, had moderate edema of the upper lid of the left eye and definite proptosis. No change was seen in the fundus. There was a purulent discharge from the left nostril. Epinephrine packs in the middle meatus and mild silver protein were used. Immediate improvement and recovery occurred within one week. Operation was advised, but was not done as recovery was so prompt. The rhinologist reported ethmoiditis.

CASE 2.—G. O., aged 4 years, had marked edema and redness of both lids of the right eye, moderate proptosis, a normal disk and a discharge of pus from a fistula above the internal canthal ligament. There were also severe acute rhinitis and otitis media. Treatment consisted of hot applications and of epinephrine and mild silver protein in the nose. An operation to enlarge the fistulous opening was suggested, but the parents refused to take the child to the hospital. The fistula closed, and the swelling and proptosis became greater. Incision and drainage were done, and recovery was satisfactory. Infection of the ethmoid sinus was suspected because the fistula occurred externally to it.

CASE 3.—H. M., aged 12 years, had a swelling of the left upper lid, tenderness over the left frontal sinus and pus in the middle meatus. There was no definite proptosis. Treatment consisted of epinephrine packs in the middle meatus and suction. Recovery occurred in ten days. The ocular condition was definitely due to an infection of the frontal sinus.

CASE 4.—B. W., aged 5 years, had swelling of the lids of the left eye, severe rhinitis and fever but no proptosis. Treatment consisted of epinephrine, and mild silver protein and cold applications. Recovery occurred in four days. The condition was probably due to ethmoiditis.

CASE 5.—L. N., aged 4 years, had edema of the lower lid of the right eye but no proptosis. A roentgenogram showed the right antrum to be cloudy. Hot applications were used. Recovery occurred in six days.

CASE 6.—M. G., aged 5 years, had marked swelling of both lids of the right eye, and severe rhinitis, but no proptosis. Treatment consisted of hot applications. Recovery occurred in three days. The ocular condition was probably due to ethmoiditis.

CASE 7.—I. R., aged 4 years, had swelling of the lids of the right eye and moderate proptosis. An external operation on the ethmoid sinus was done, and pus was found in the ethmoid sinus and in the antrum. Recovery occurred in a few days.

CASE 8.—P. K., aged 1½ years, had moderate edema and redness of both lids of the left eye, but no proptosis, conjunctival congestion or discharge. Pus was discharged from the left nostril. Treatment consisted of epinephrine and neosilvol. Complete recovery occurred in two days. The ocular condition was probably due to ethmoiditis.

CASE 9.—T. G., aged 3 months, had marked edema and redness of the upper lid of the left eye, moderate proptosis and a temperature of 102 F. Both lids became swollen; then the swelling subsided, but the proptosis increased. Motility of the eyeball became restricted, but the disk remained normal. There was moderate chemosis of the nasal side, and induration of the subcutaneous tissues developed below the internal canthal ligament. The subcutaneous abscess pointed at the site of induration. An incision was made with a Graefe knife, and from

2 to 3 drachms of pus was evacuated. No drain was used. The incision was reopened in twenty-four hours with a grooved director, but no pus was found. The proptosis was gone in twenty-four hours. A slight convergent squint was present for several weeks, probably due to the eye being closed so long (three weeks). The ocular condition was probably due to infection of the ethmoid sinus.

CASE 10.—D. S., aged 2½ years, had a severe cold in the head for two weeks, following which fever developed and both lids of the right eye became red and edematous. There was moderate proptosis, with little chemosis and slight subcutaneous induration over the region of the ethmoid sinus. The swelling of the lid subsided in twenty-four hours, but the proptosis increased.

Motility remained good, and the temperature became normal in three days. The child was discharged from the hospital on the ninth day, almost completely recovered. Treatment consisted of ephedrine, epinephrine and neosilvol in the nose, and hot boric acid dressings. A roentgenogram showed that the ethmoid sinuses were clear and both antrums cloudy.

CASE 11.—M. F., aged 5 years, had a cold in the head for two weeks, following which the upper lid of the left eye became swollen over night. Then both lids became markedly swollen and tense, so that she could not open her eyes. The edema of the lids spread across the nose, and the lids of the right eye became swollen. The eyeball was displaced forward and outward. It was partly fixed. There was some chemosis on the nasal side of the eyeball, and the retinal veins were moderately engorged, but the pupil was small and reacted normally, and vision was good. The swelling of the lid became less, but the proptosis increased, and induration appeared over the region of the ethmoid sinus externally. Eight days after the onset of the condition, an incision was made into the indurated area with a Graefe knife, and a moderate amount of pus was evacuated. No drain was used, but the incision was reopened with a grooved director daily for six days. Recovery was complete. The ocular condition was probably due to ethmoiditis. Treatment consisted of epinephrine, ephedrine and neosilvol in the nose throughout her stay in the hospital.

CASE 12.—J. P., aged 4 months, had marked swelling of the lids of the left eye for four days following an infection in the upper respiratory tract. On admission there was marked proptosis, and the cornea was clear; the size of the pupil and the reaction were normal, and the media were clear. The lid felt hardest at the outer canthus. The white blood count was 18,000. On the day of admission the abscess ruptured spontaneously, discharging 4 drachms of yellow pus through a fistula in the conjunctiva near the outer canthus. The next day there was no drainage from the fistula, and there was a beginning abrasion of the lower part of the cornea. The fistulous tract was opened widely; pus was evacuated and a drain inserted. Both ear drums were red and swollen. The cornea became more infiltrated, and the proptosis and chemosis were increased in twenty-four hours, so the drain was omitted and the opening was spread with a small hemostat daily until the discharge ceased. The child was discharged in two weeks with some opacity of the cornea and moderate paresis of the left external rectus muscle owing to the formation of scar tissue. The child was followed carefully, and the paresis of the muscle and corneal opacity practically disappeared within a few months. Culture of the pus showed Staphylococcus albus. A roentgenogram showed indistinct ethmoid sinuses but clear antrums.

CASE 13.—C. A., aged 9, had marked swelling of the lids of the right eye of four days' duration. The right eye was markedly proptosed, forward and

laterally. There was a profuse bloody discharge from the right nostril. The white cell count was 14,200. Twenty-four hours later an incision was made into the lower part of the orbit adjacent to the antrum, serosanguineous pus being evacuated. A gutta-percha drain was inserted. Drainage was not satisfactory, and the temperature rose to 105 F. Consultation with the rhinologic and laryngologic department was held. An external opening was made into the ethmoid sinuses and a window resection into the antrum, and rubber tube drains were inserted. An abscess formed in the roof of the mouth which was opened and drained. Improvement was marked in four days and complete in four weeks. Cultures of the pus revealed Staphylococcus aureus. The diagnosis was osteomyelitis of the ethmoid and superior maxillary bones.

CASE 14.—E. L., aged 3 years, had redness and swelling of the cheek and the lower lid of the left eye, but no proptosis. The tear sac was normal. The abscess ruptured spontaneously and drained for five days. There was complete recovery. Treatment consisted of hot dressings. A roentgenogram showed a cloudy left antrum.

CASE 15.—L. P., aged 3 years, had markedly swollen lids of the right eye and some proptosis. Spontaneous recovery occurred in ten days. Treatment consisted of epinephrine and ephedrine in the nose. The ocular condition was probably due to ethmoiditis.

CASE 16.—R. S., aged 10 years, had swollen lids and moderate proptosis of the right eye. Spontaneous recovery occurred in seven days after treatment with hot compresses, epinephrine and suction. A roentgenogram showed clouding of the right antrum.

CASE 17.—L. B., aged 1 year, had a cold for three weeks, following which both lids became markedly red and swollen, and there was some proptosis. There was profuse nasal discharge on the right side. The white blood count was 18,000. The temperature was 101.6 F. Complete recovery occurred within three days. Treatment consisted of cold compresses, ephedrine and neosilvol. The ocular condition was probably due to ethmoiditis.

CASE 18.—H. P., aged 12, had an attack of scarlet fever, during which profuse rhinitis developed, followed by swelling of the lids of the left eye and proptosis. There was no fixation of the eyeball, and the fundus was normal. The ocular conditions subsided after treatment with ephedrine in the nose and nasal suction. Several days later suppurative arthritis developed in each wrist, which became so severe that surgical treatment was necessary. Sepsis developed, and the child died. The ocular condition was probably due to ethmoiditis.

CASE 19.—J. S., aged 3 years, had an infection in the upper respiratory tract following which the upper lid became markedly red and swollen; there was moderate proptosis. The cornea was clear and the fundus normal. The temperature was 103 F., and the white cell count 14,500. Three days later both lids were swollen, and there was some induration near the inner canthus. Three days later recovery was practically complete. Treatment consisted of ephedrine and epinephrine in the nose, nasal suction and hot applications. There was a history of a similar attack in the same eye a year previously.

CASE 20.—S. R., aged 7 months, had swelling and redness of the upper lid of the left eye but no chemosis or proptosis and no fixation of the eyeball. The white cell count was 14,600. Pus was found in the left middle meatus. Rapid improvement occurred in twenty-four hours and complete recovery in five days. Treatment consisted of ephedrine and neosilvol in the nose, nasal suction and hot applications. A roentgenogram showed a suggestion of slightly increased density in the region of the ethmoid sinuses.

CASE 21.—T. R., aged 2 years, was the sister of the patient in case 20. Both children had a similar condition at the same time. Following an acute infection of the upper respiratory tract, the lids of the left eye became red and swollen. Marked improvement followed the use of ephedrine and neosilvol in the nose and hot applications for a week; then the lids became swollen again, more so than the first time. There was a profuse discharge from the left nostril. Treatment was continued, but an area of subcutaneous induration developed above the internal canthal ligament, and slight proptosis occurred. The indurated area was incised with a Graefe knife, and a grooved director was inserted deep toward the ethmoid cells. Considerable pus escaped. A gutta-percha drain was inserted. Three days later the incision was healed. Some induration persisted at the site of incision for several weeks, and there was a little convergent squint for a few weeks. The fundus was normal throughout the course of the disease. A suggestion of crepitus was present when pressure was made over the area of the ethmoid sinus for several weeks after the patient left the hospital. The ocular condition was probably due to ethmoiditis.

Fig. 1 (case 20).—*A*, edema of the lids; ethmoiditis. *B*, six days later; recovery without surgical treatment.

Orbital Inflammation Due to Osteomyelitis of the Maxilla.—CASE 22.—F. D., aged 1 year, had a cold, and two weeks later the lids of the left eye became so swollen that the eye could not be opened. Also, the left side of the face became swollen, bluish and indurated. The eyeball was normal. An incision was made into the indurated tissues above the canine fossa. There was some drainage. Pneumonia developed, and the child died. The diagnosis was osteomyelitis of the maxilla.

Orbital Inflammation Due to Traumatic Periostitis of the Orbit.—CASE 23.—R. R., aged 2 years, fell, striking his right cheek against the door casing, resulting in a small laceration of the skin. The lower lid of the right eye became swollen the next day. Five days later the lower lid was indurated, and a small amount of pus drained through a small opening in the skin over the center of the lower orbital rim. The opening was enlarged, but there was little drainage. A week later the temperature was 103 F.; the lower lid was greatly swollen, and the lower rim of the orbit was thickened. An incision was made again, and 4 cc. of pus was evacuated. In several days the drainage ceased, but the lid

remained swollen, lumpy and indurated. A preparation of tin was given by mouth for one week, but was discontinued because the eyeball became markedly proptosed, rotated down and in and pushed downward. Upward rotation was very restricted. The fundus was normal. Arrangements were made to explore the orbit, but definite improvement occurred spontaneously, so nothing was done. Gradual improvement in the proptosis and deviation of the eye took place in the following month. The diagnosis was periostitis of the lower rim and the wall of the orbit.

Orbital Inflammations Due to Periostitis or Osteomyelitis, Probably Embolic.—CASE 24.—J. L., aged 13 months, had had whooping cough for two months prior to operation and swelling of the upper lid for two days. The temperature was 105 F. Convulsions occurred. The white cell count was 14,600. No proptosis was present. There was a profuse nasal discharge. The swelling and induration were greater in the center of the upper lid. An incision was made just below the center of the brow, pus was evacuated and a drain inserted. Healing was

Fig. 2 (case 21).—*A*, edema of the lids; ethmoiditis. *B*, six days later; subcutaneous induration above the internal canthus. An incision was made in the indurated area, and the pus was evacuated. The patient recovered.

complete in ten days but pseudoptosis was present. A roentgenogram showed that the frontal sinuses were not pneumatized, and there was no evidence of a pathologic process in the orbit. A culture showed the pneumococcus.

CASE 25.—D. H., aged 1 month, had an abscess of the left breast soon after birth, which was opened and squeezed. Nine days after birth swelling began in the left upper lid. A soft, pale, fluctuant mass formed under the brow. The eyeball pushed forward and down. The left pupil was larger than the right, and there was no reaction to light. The retinal veins were engorged near the disk. The white cell count was 60,000. Aspiration of the mass yielded 10 cc. of mucus and pus. The laboratory report showed mucin, pus cells and Staphylococcus citreus. An incision was made through the temporal half of the upper lid, and 5 cc. of pus was evacuated. A drain was inserted. The proptosis subsided. Empyema of the left side of the chest developed from which Staphylococcus citreus was recovered. The ocular condition did fairly well for two weeks, then became worse and a larger incision was made. An abscess formed in the left breast, which was incised, and Staphylococcus citreus was found. The opening in the lid drained for a month more, and the opening had to be enlarged again.

The fistula continued to discharge, but no radical treatment was advised because of the empyema. Six months later the child was readmitted to the hospital. There was a discharging fistula, with depressed scar formation in the upper lid, and a loose piece of bone could be felt with a probe. An incision was made, and

Fig. 3 (case 22).—Osteomyelitis of the maxilla; death from pneumonia following incision.

Fig. 4 (case 23).—*A*, periostitis of the lower rim and wall of the orbit, due to trauma. *B*, one month later, following incision and evacuation of pus.

a sequestrum 1 cm. in diameter was removed. It was evidently a piece of the roof of the orbit. No cerebrospinal fluid escaped. Recovery was prompt. The discharge ceased, and the proptosis subsided. Nine months later examination showed the disk, pupillary reactions and motility of the eye to be normal. The eye was slightly proptosed and pushed down. The deformity of the upper lid was barely noticeable.

CASE 26.—R. L., aged 7, had scarlet fever, during which the left upper lid became markedly swollen, then the lower lid. The eyeball became markedly proptosed. Some erosion of the lower part of the cornea developed. Induration and later fluctuation developed in the center of the swollen upper lid just below the brow. An incision was made and a grooved director inserted. Considerable

Fig. 5 (case 25).—*A*, Aug. 28, 1930; metastatic osteomyelitis of the roof of the orbit; large fluctuant mass below the brow. *B*, March 28, 1931; discharging fistula in the upper lid; loose piece of bone felt with a probe.

Fig. 6 (case 25).—*A*, April 15, 1931; after sequestrum from the roof of the orbit had been removed. *B*, Jan. 11, 1933; recovery satisfactory.

pus was evacuated. The incision was reopened daily until the drainage ceased. Several days after the incision an abscess formed on the forehead, one on the temple and one over the sternum, all of which were incised after they became very soft. There was a discharge from both ears. The proptosis subsided, and the incision in the lid healed without any depressed scar. A marked opacity of

the lower third of the cornea was left which had a clear 2 mm. area in it which resembled a descemetocele, but it did not bulge. Some months later, as a result of crying, the clear area broke open and aqueous spurted out. A sliding conjunctival flap was made which covered the defect and gave a good result. The vision is practically the same as before the disease began. This child has been very myopic since infancy. Before the illness the refraction in the left eye was $-8.00 -1.50$ axis $180 = 20/25$. For about six weeks after the conjunctival flap was made it decreased to $-5.00 -1.50$ axis $180 = 20/30$. It is true that all of the abscesses in this child healed without adherent depressed scars, yet the fact that they all occurred over bony tissues suggests that they arose in the periosteum. In this case the prominence of the eye and lack of resistance of the cornea due to the myopia probably increased the possibility of damage to the cornea.

SUMMARY OF CASES

	Right Eye	Left Eye	Total
Total number of cases	9	17	26
Cases due to osteomyelitis or periostitis	1	4	5
Cases due to sinus infection	8	13	21
Cases due to frontal sinus infection	0	1	1
Cases due to ethmoid infection	4	11	15
Cases due to antrum infection	3	1	4
Cases due to antrum and ethmoid infection	1	0	1
Cases of proptosis	8	9	17
Cases of spontaneous recovery	5	8	13
Cases in which incision only was done	2	8	10
Cases in which radical operation was done	2	1	3
Cases of proptosis in which spontaneous recovery occurred	4	3	7

Mortality And Permanent Ocular Defects.—Two patients died, 1 of pneumonia soon after incision for osteomyelitis of the maxilla and 1 of sepsis and suppurative arthritis of the wrists several weeks after the proptosis had subsided spontaneously. Corneal ulcers developed in 2 patients; 1 ulcer perforated, but practically normal vision resulted in each case. There was 1 case each of moderate paresis of the external rectus and of the levator.

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THE EYE OF THE TROUT

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In connection with a series of studies carried out under the direction of Dr. Emeline Moore of the Conservation Department of the State of New York, the eyes of a number of trout were studied, and some of the results of these studies are presented at this time both as a contribution to the comparative anatomy of the eye and as an introduction to further researches, which it is hoped will be completed soon and which have a definite bearing on human ophthalmology.

From time to time, papers have appeared on the comparative anatomy of the eye, and although the many marked anatomic differences between the eyes of fishes and of mammals have been casually noted, no great stress seems to have been laid on them. As would naturally be expected, owing to the environment of fish, their refractive problems are considerably different from those of mammals. Still further, owing to the various pressures to which a fish is subjected as it goes from the surface to the bottom of the lake, stream or ocean in which it lives, its eyes have special anatomic features which are not found in other forms. Also, there are other differences which permit vision under conditions of lighting totally different from those found either on land or in the air. With this introduction, it is possible to consider in detail the eye of a particular fish, the Rainbow trout (Salmo gairdneri irideus, Gibbons), a typical member of the Salmonidae.

GROSS ANATOMY

In an adult trout measuring about 40 cm. in length, the diameter of the eye at the equator is found to be between 10 and 15 mm. The eye is ellipsoidal except for the corneal portion, which is nearly flat. Situated on the side of the head with the optical axis practically perpendicular to the longitudinal axis of the body, the cornea of a normal fish is only 1 or 2 mm. above the level of the circumorbital bones, the diameter of whose distal opening is usually 1 or 2 mm. less than the maximum diameter of the eye. Proximally the orbit is heavily lined with fat, which presumably acts as a cushion for the eye under the pressures externally applied to it at great depths. Although there are external muscles similar to those of the mammalian eye, little, if any, motion is to be observed in the fish's eye. These external muscles probably act in conjunction with the orbital fat as a protective mechanism against pressure. The iris is

a silvery olive green, and from 1 to 2 mm. in width, with a round or slightly oval pupillary opening from 7 to 9 mm. in diameter. The anterior chamber rarely exceeds 1 mm. in depth, which brings the nearly spherical lens close to the posterior surface of the cornea.

Extending from the posterior portion of the eye through the vitreous to the posterior surface of the lens is a structure called the falciform process, which will be described later. Figure 1 is a schematic diagram of the eye of a trout which shows the general shape, size and relationship of the individual structures and portions.

Fig. 1.—Diagrammatic section of a trout's eye.

THE CORNEA

The cornea is from about 0.7 to 0.8 mm. in thickness and can be conveniently divided histologically into five parts. In figure 2 it can be seen that anteriorly there is an epithelial layer consisting of a closely packed portion of nucleated cells next to a portion of elongated cells separated from the fibrous substantia propria by an ill-defined anterior limiting membrane. Posteriorly, the cornea is bounded by a posterior limiting membrane (similar to the membrane of Descemet) and the endothelial layer, as shown in figure 3.

THE IRIS

The iris is usually of a silvery olive green color and rarely more than 1.5 mm. in thickness. Microscopically, it appears to consist of a

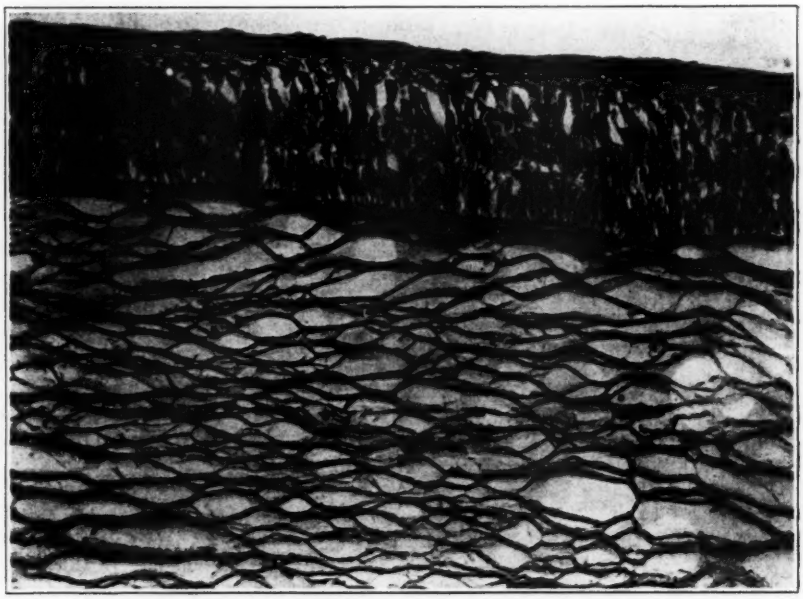

Fig. 2.—Anterior portion of the cornea.

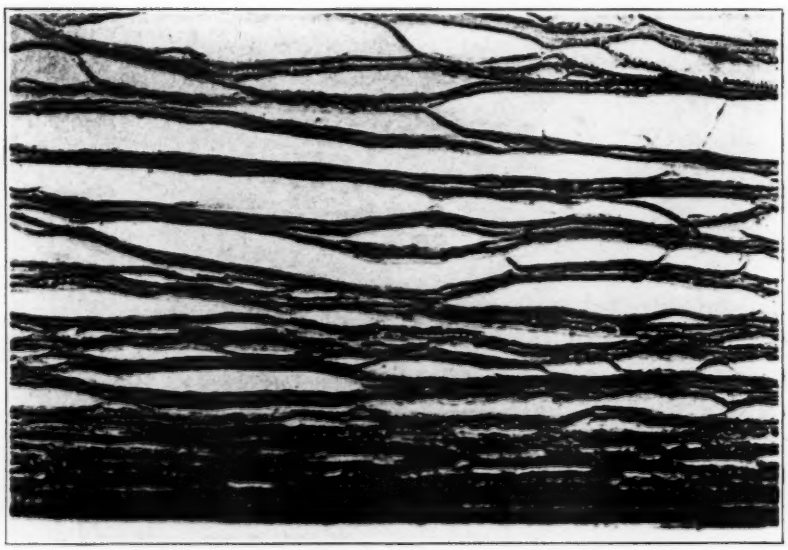

Fig. 3.—Posterior portion of the cornea.

posterior pigmented layer which in all probability is similar to that portion of the human eye known as the pars iridica retinae. The structure of this pigmented portion, shown in figure 4, consists of a posterior layer of cells, anterior to which is found the layer of pigment, all of which appear to be attached to the remainder of the iris by a fine bridgework-like structure. The iris itself is vascular and contains some fibrous tissue, but as it is not of the active type, as far as observations can determine, there is practically no true muscular structure. The peculiar manner in which the pigmented layer is attached to the rest of the iris may be to provide an additional elasticity to this structure

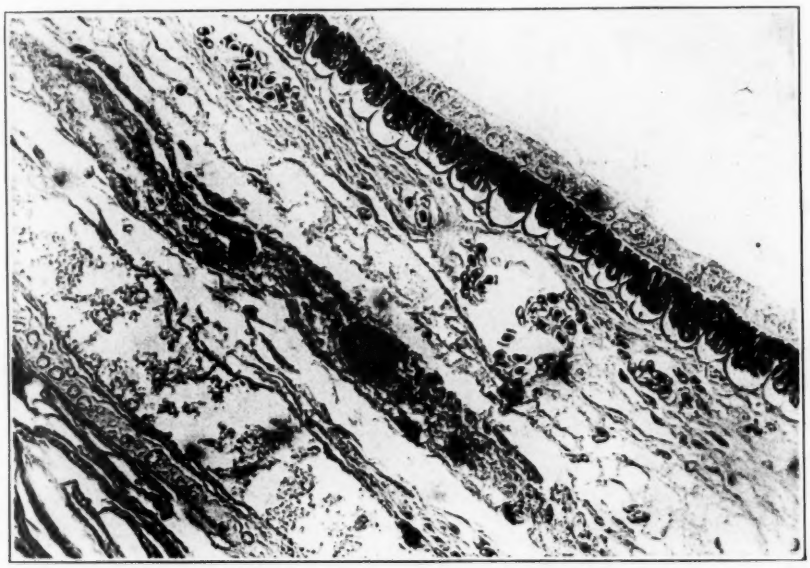

Fig. 4.—Iris.

against which the lens rests, and to provide flexibility, which is obviously necessary if accommodation is accomplished by an actual mechanical displacement of the lens, as it is commonly believed occurs in fish.

CHOROID AND SCLERA

There is little about either the choroid or the sclera of the trout's eye to warrant extended or detailed description. The choroid is the main vascular tunic, the trout's eye differing from the mammalian eye in that there are not many definitely differentiated blood vessels; the blood circulates through the various portions of the eye by way of sinus-like blood-filled spaces. One of these can be readily seen in figure 5.

The sclera is practically cartilaginous, as can be easily seen in figures 5 and 6.

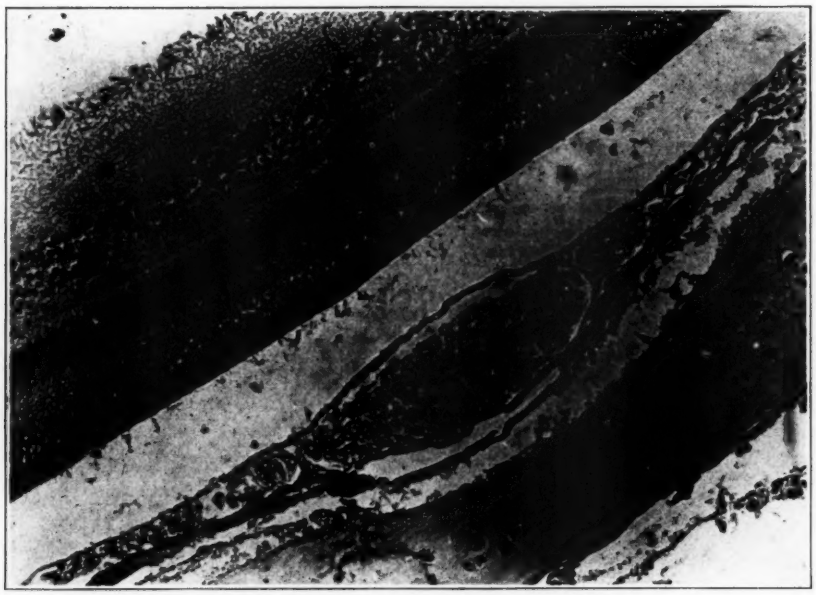

Fig. 5.—Retina, choroid and sclera.

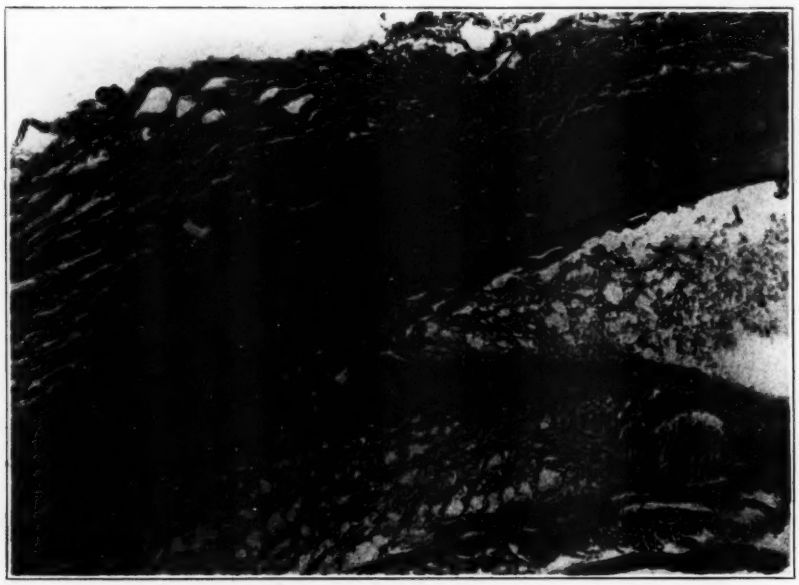

Fig. 6.—Cornea and sclera.

THE LENS

In an adult trout the lens has a diameter of about 4 mm. When cut parallel to the optic axis, the lens presents a parallel structure which under high magnification resolves into a series of parallel fibers with finger-like interlacings. When cut normal to the optic axis it has a typical annular appearance. The lens is enclosed in a capsule composed of two distinct layers: an outer layer of a more or less fibrous nature and an inner nuclear layer, about twice the thickness of the fibrous layer, containing round, distinctly staining nuclei the diameters of which

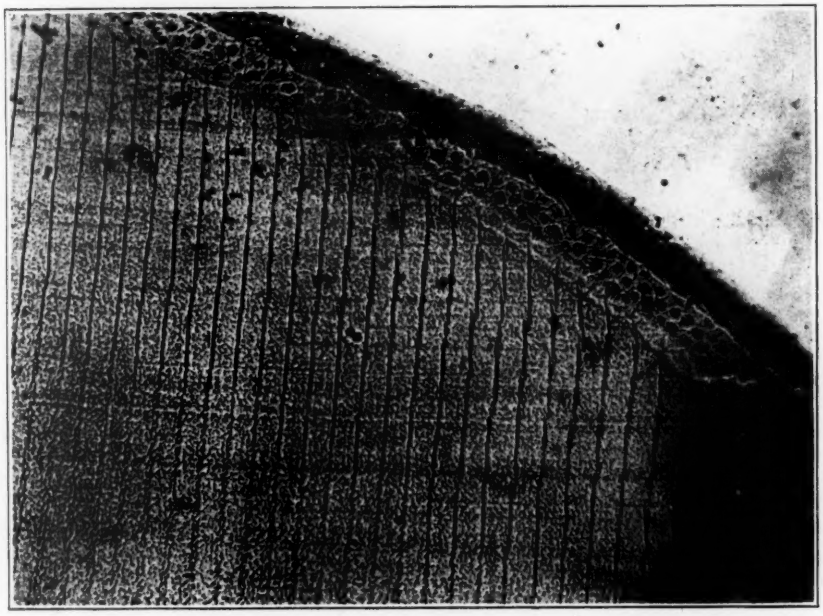

Fig. 7.—Lens and capsule.

are about half the thickness of the nuclear layer. These nuclei show a granular structure, and are regularly spaced. There appears to be a membranous separation between the outer fibrous layer of the capsule and the inner nucleated layer. Figure 7 shows the capsular and nuclear portions of the lens, while figure 8 is a photomicrograph taken at high magnification, showing the peculiar intricate manner in which the various cells of the lens adjoin each other. Such a structure leads to the obvious inference of an increased surface area of the individual lens cells whereby nutrition is facilitated by the presentation of a large surface area to such fluids as may penetrate the capsule.

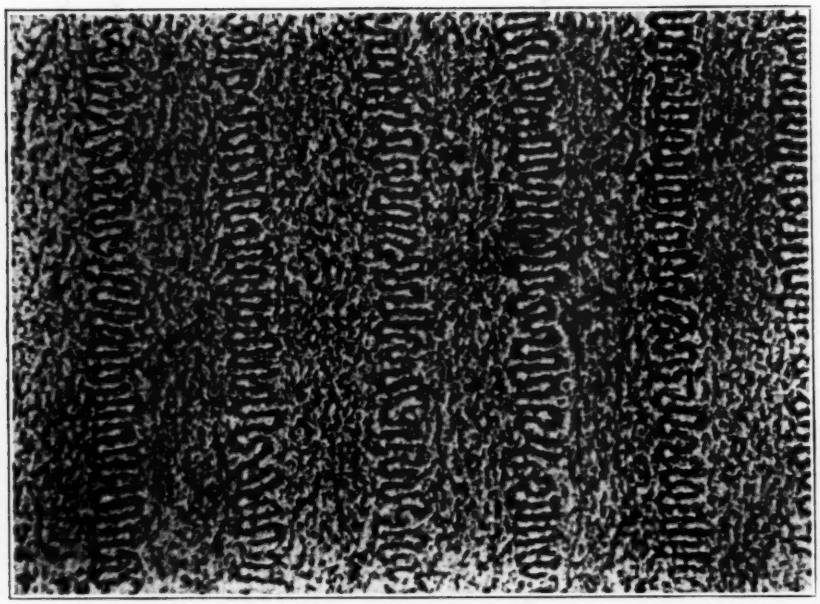

Fig. 8.—Lens fibers under high magnification.

Fig. 9.—Retina.

THE RETINA

The retina of the trout is rather surprisingly similar to that of the human eye. It is comprised of approximately the same number of layers of which the following is a description:

(*a*) Immediately in contact with the vitreous one finds a fibrous-appearing layer, from 30 to 70 microns in thickness, slightly serrated at its surface (which may be due to poor fixation technic), containing scattered nuclei, from 6 to 9 microns in diameter, throughout its substance, and a basal layer of nucleated cells with pronounced granular nuclei. This basal portion has a reticulated appearance and is about

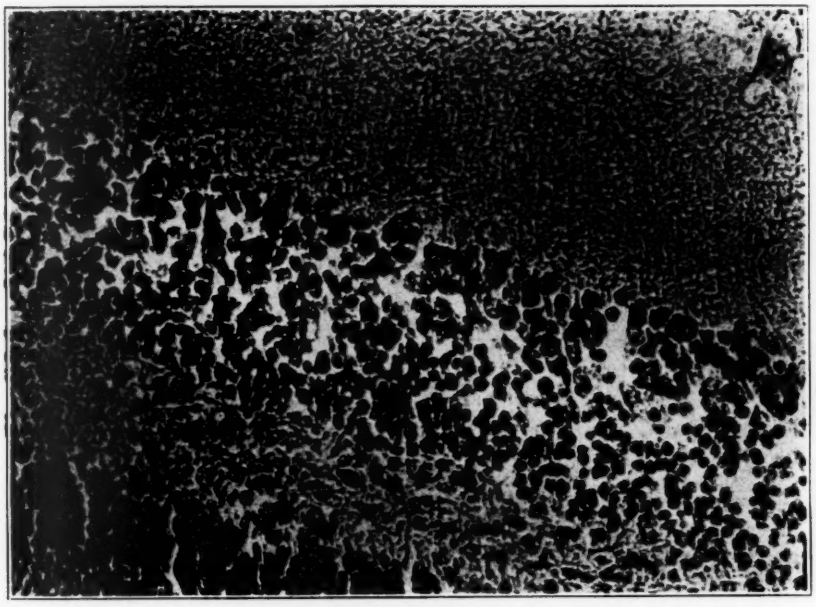

Fig. 10.—Retina.

15 microns thick. The whole layer corresponds to the ganglion cells of the human retina (fig. 9).

(*b*) Next in order follows a highly compact layer about 90 microns thick, corresponding to the inner plexiform layer and showing occasional spaces adjacent to the nucleated portion of the first layer but being more or less structureless throughout the rest of its substance (fig. 9).

(*c*) Following this is what might be termed an inner nuclear layer, approximately 60 microns thick; the nuclei are dark staining with hematoxylin, have an average diameter of 7.5 microns and appear to extend outward toward the next successive layer (fig. 10).

(*d*) The fourth layer corresponds to the outer plexiform layer, is about half the thickness of the previous one (averaging 30 microns)

and appears to contain a certain amount of fibrous tissue, the fibers of which run longitudinally. There are occasional nuclei about 7.5 microns in diameter (fig. 10).

(*e*) The fifth layer corresponds to the outer nuclear layer and is about 75 microns thick. It appears as a dark-staining compact layer of cuneiform cells, the extensions of which appear to run back into the sixth layer (fig. 11).

(*f*) The rods and cones, the former outnumbering the latter by about 10 to 1, comprise the sixth layer, which has a thickness of from 100 to 120 microns and which merges almost imperceptibly into the outermost layer (fig. 11).

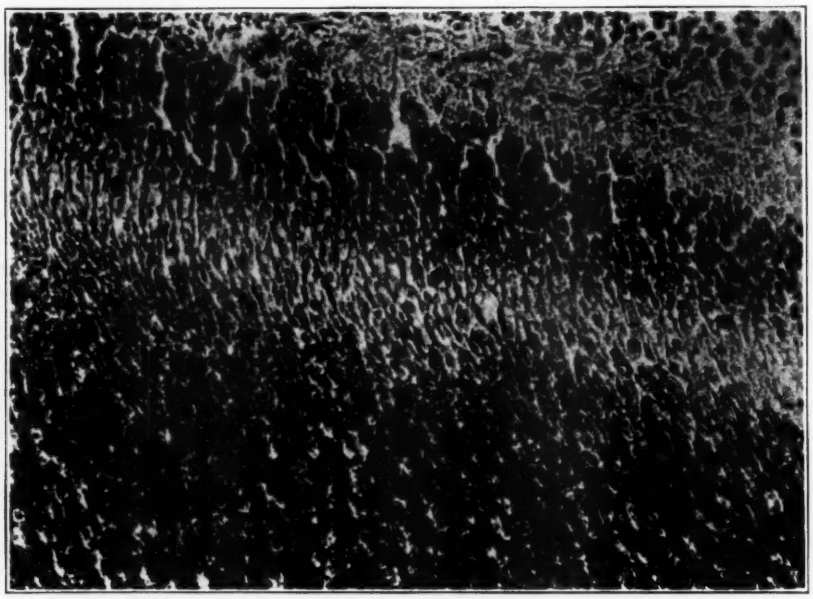

Fig. 11.—Retina.

(*g*) The pigmented layer with its external limiting membrane appears dark in stained sections and contains small intercellular spaces. It is comparatively compact in most places, and appears to be comprised of groups of highly refractile bodies which in all probability are crystals of guanine. Incidentally, these pigmented bodies are to be found scattered throughout the substance of the retina, but it is quite probable, from the fact that they appear to be on the surface of the section, that they have been dragged from their true locations by the microtome knife.

THE FALCIFORM PROCESS

At the posterior portion of the eyeball, adjacent to the entrance of the optic nerve, there occurs a fold of the choroid known as the falci-

form process, terminating with its anterior portion (campanula halleri) in contact with the lens. This is believed by its contraction and expansion to provide mechanical displacement of the lens and thus to accomplish "accommodation."

The process appears as a slightly fibrous extension of the choroid, extending through the retina and vitreous, and contains little or no blood.

There is a possibility that either lymph channels in its substance or tubules of some nature communicating with the lens may be pathways for nutrient substances.

SUMMARY

1. A description is given of the essential histologic features of the eye of the trout.

2. A suggestion is made as to a possible means (the falciform process) by which the lens has contact with the general blood stream, which may account for the high incidence of pathologic lenses in fishes.

CATARACT IN THE ALBINO MOUSE RESULTING FROM A DEFICIENCY OF VITAMIN G (B_2)

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AND

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It was shown in a previous paper [1] that keratitis and cataract develop in albino rats restricted to a diet deficient in vitamin G, and it has also been shown [2] that Norway rats respond in like manner. More recent experiments [3] with modifications of the deficient diet yielded similar results. O'Brien [3a] has also reported cataract resulting from vitamin G deficiency. In order to demonstrate whether or not such deficiency lesions are common to mammals in general, other species have been subjected to a similar dietary regimen. The purpose of this paper is to report the production of cataract and other ocular changes in albino mice by the administration of a vitamin G-deficient diet. Bing and Mendel [4] studied the effect of vitamin G deficiency on the albino mouse and reported that, in addition to dermatitis, the eyelids became inflamed and adherent in one animal.[5]

EXPERIMENTAL WORK

The mice used in the experiments herein reported were bred in our laboratory. Sherman's diet 13,[6] supplemented with fresh lettuce, was

From the Departments of Anatomy, Physiological Chemistry and Ophthalmology, School of Medicine, University of Arkansas.

1. Day, P. L.; Langston, W. C., and O'Brien, C. S.: Cataract and Other Ocular Changes in Vitamin G Deficiency, Am. J. Ophth. **14**:1005 (Oct.) 1931.

2. Langston, W. C., and Day, P. L.: Nutritional Cataract in the Norway Rat (Mus Norvegicus), South. M. J. **26**:128 (Feb.) 1933.

3. Day, P. L., and Langston, W. C.: Further Experiments with Cataract in Albino Rats Resulting from the Withdrawal of Vitamin G (B_2) from the Diet, J. Nutrition, to be published.

3a. O'Brien, C. S.: Experimental Cataract in Vitamin G Deficiency, Arch. Ophth. **8**:880 (Dec.) 1932.

4. Bing, F. C., and Mendel, L. B.: The Vitamin B and the Vitamin G Requirements of the Albino Mouse, J. Nutrition **2**:49 (Sept.) 1929.

5. For references to papers on the pathology of vitamin G deficiency in the rat, see the bibliographies appended to the articles already cited.

6. Sherman, H. C., and Campbell, H. L.: Growth and Reproduction upon Simplified Food Supply: IV. Improvement in Nutrition Resulting from an Increased Proportion of Milk in the Diet, J. Biol. Chem. **60**:5 (May) 1924.

used as a stock diet. The young used in the experiment were separated from their mothers as early as they could survive on a solid diet. This was found to be at about 14 to 16 days of age (from 6 to 9 Gm. in weight). They were placed in metal cages with raised screen floors, and were given the same vitamin G-deficient diet that was used for rats.[7] This diet (625) has the following composition: casein (freed from water-soluble vitamins by treatment with 60 per cent alcohol), 18 per cent; Osborne and Mendel salt mixture, 4 per cent; cod liver oil, 2 per cent; butter fat, 8 per cent, and corn starch, on which an 80 per cent alcoholic extract of rice polish has been evaporated, 68 per cent.

Owing to the inability of some of the young mice to survive on a solid diet, the mortality rate was high during the early weeks of the experimental period. In a series of seventy-three young animals placed on the diet, twenty-six died before the expiration of the minimum time of appearance of cataract (thirty-five days). Therefore, only the remaining forty-seven animals are considered in the tabulations.

All animals included in the tabulations were observed weekly, by both gross observation and ophthalmoscopic examination. The pupils were dilated with 0.5 per cent atropine sulphate solution. Histologic sections were made from the eyes of twenty animals. Some of these were taken from mice dying as a result of the deficiency, while others were from animals which were killed at arbitrary intervals for the purpose of checking the ophthalmoscopic findings with the histo-pathologic picture. Animals from the same stock receiving a normal diet were found to be entirely free from the deficiency manifestations considered here.

Growth.—Figure 1 shows typical weight curves of mice studied in these experiments. In general, the animals remained practically constant in weight, or showed meager gains, for four or five weeks. After a brief period of decline in weight, they died. The average period of survival was seventy-two days. However, certain animals started growing rather rapidly after a period of practically no growth. Apparently such animals learned to practice coprophagy,[8] and thus obtained access to a source of vitamin G. The case of mouse 66 (fig. 1) is typical.

Incidence of Ocular Changes.—Of the forty-seven animals considered, keratitis was manifested in thirty-seven (79 per cent): in thirty by ophthalmoscopic examination and in seven additional by histologic section. Cataract was found in forty-five (96 per cent): in forty by the

7. Day, Langston and O'Brien (footnote 1). Langston and Day (footnotes 2 and 3).

8. Page, J. W.: An Improvement in Experimental Method for Investigation of Vitamin G, Proc. Soc. Exper. Biol. & Med. **30**:87 (Oct.) 1932.

ophthalmoscope and in five additional animals by histologic section. General ophthalmia was observed in twenty-seven animals (57 per cent).

Gross Findings.—As contrasted with the general manifestations of the deficiency, as seen in previous experiments on albino rats and wild gray rats, the gross findings in albino mice were few and not striking. In only a few of the animals was any alopecia observed and then only in a slight degree. The hair appeared clumpy and lacked the silky luster of a normal mouse (fig. 2). Cutaneous ulceration was rarely seen, and little dermatitis was manifested. No nervous manifestations were observed. Salivation, stomatitis and labial crusting were virtually absent. A few animals showed a mild diarrhea in later stages of the

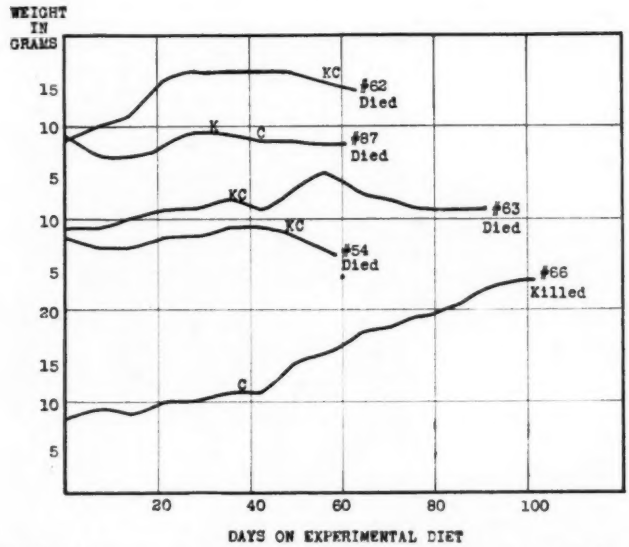

Fig. 1.—Weight curves of albino mice restricted to a diet deficient in vitamin G. Mice 54, 62 and 87 represent typical cases. Certain animals, of which mouse 66 is an example, apparently obtained access to a source of vitamin G, probably by coprophagy. *K* indicates keratitis; *C*, cataract.

deficiency. About the fifth or sixth week of the experimental period the eyes of many animals showed increased lacrimation and a mild reddening of the margins of the lids. At times the lids became slightly adherent; practically all the animals showed some decrease in the palpebral aperture. A week or two later a slightly hazy appearance of the globe of the eye was noted. Subsequently this haziness of the anterior portions of the globe gave way to a denser, whitish appearance. In later stages (the seventh to the ninth week) a general ophthalmia was observed. The lids were swollen and inflamed, and a sanguinopurulent or purulent exudate was observed. During this stage the eyes became sealed, and frequently were entirely encrusted with solidified

exudate. In most cases death soon followed the appearance of such a condition. A few animals showed corneal ulceration.

Ophthalmoscopic Findings.—These findings were fairly consistent. The first manifestation noted was that of a superficial keratitis associated with a mild conjunctivitis. Vascularization of the periphery of the cornea was noted in a majority of cases. As the experiment continued, the inflammatory changes in the cornea tended toward recession with residual scarring.

The changes in the lens may be divided into three stages. The first was that of an irregularity of refraction seen as sectors of light

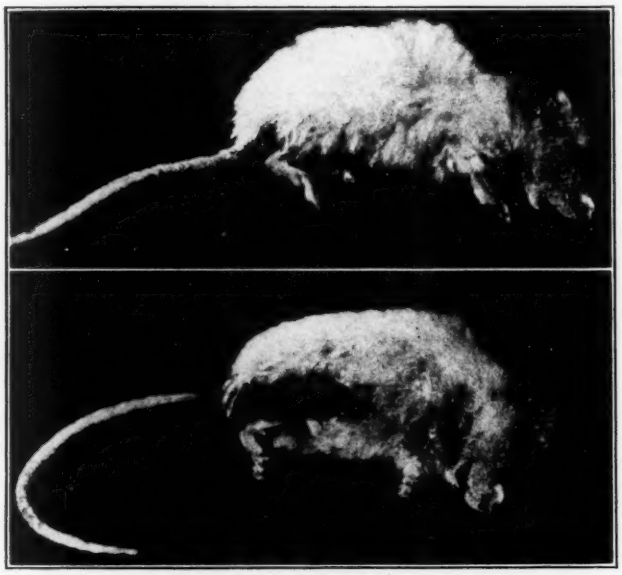

Fig. 2.—Photographs of a mouse showing the effect of withdrawal of vitamin G from the diet. The animal was photographed under ether anesthesia.

and shadow. This was especially noted in the cortex. Subsequent study of histologic sections of such lenses suggested that these sectors of light and shadow were due to early separation of lens fibers. The second stage was characterized by the formation of spicules, or striae, extending from the ciliary region toward the nucleus. In several cases a ringlike opacity was noted, resembling a lamellar cataract. These changes were usually seen during the period of recession of the inflammatory changes in the cornea. The final stage was that of a complete opacity of the lens, which went on to maturity if the animal survived for a sufficient period.

The changes in mouse 71 can be taken as typical. None were noted until the thirty-sixth day, at which time the right eye showed some sectors of light and shadow. The left cornea showed a fine keratitis;

the lens was clear. On the forty-fifth day the right lens showed fine granular opacities of the entire cortex; the cornea was clear. The left lens showed similar but slightly heavier opacities than those on the right; the left cornea was now entirely clear. On the eighty-third day both lenses showed almost mature cataracts.

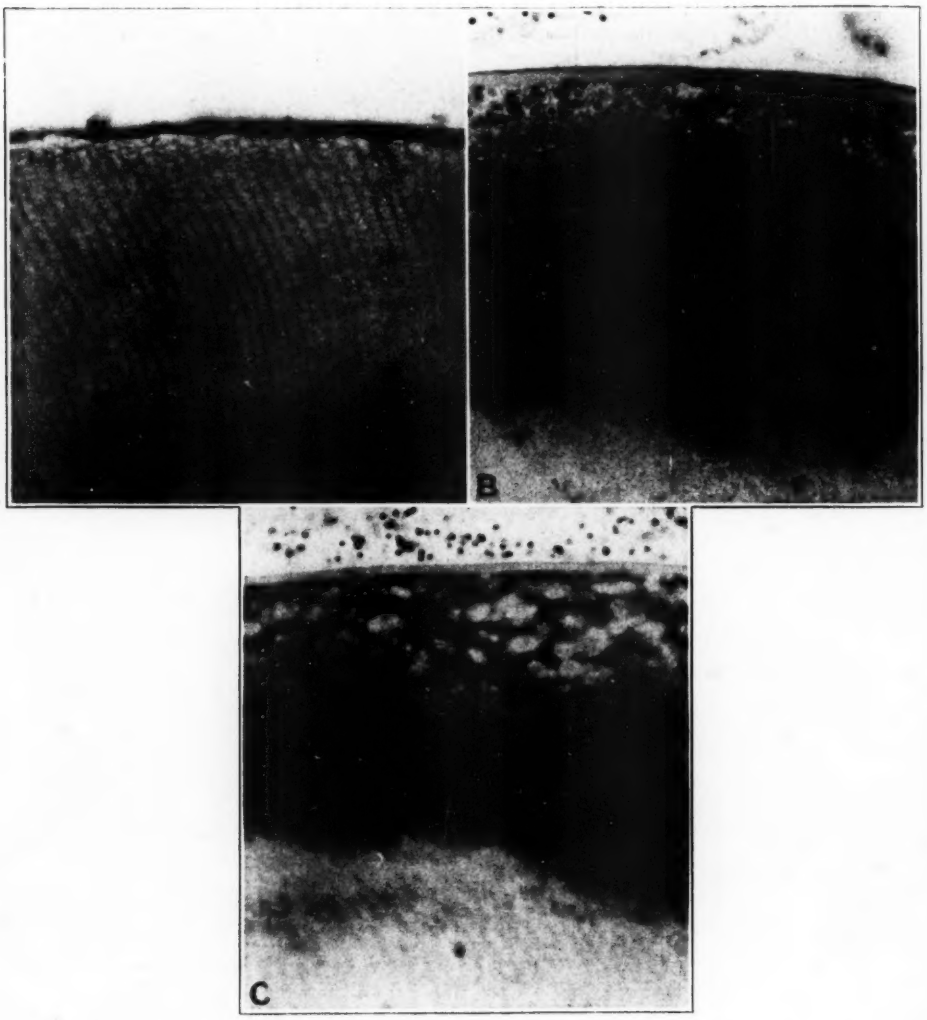

Fig. 3.—Photomicrographs of segments of lens taken from mice fed a vitamin G-deficient diet. *A* represents an essentially normal lens except for early subcapsular vacuolization of lens fibers. *B* and *C* show distinct cataractous changes.

Histopathologic Changes.—Sections were made from the eyes of twenty animals. The globe of each eye was fixed in Bouin's solution, dehydrated, sectioned in celloidin and stained with hematoxylin and eosin.

Proliferation of the anterior corneal epithelium was noted. Some fields showed the cells of all corneal epithelial layers, except the basal layer, flattened and elongated. Frequently the epithelial cells were quite irregular in their arrangement, individual cells being displaced from their regular row. In some areas, the changes in the epithelium resembled ordinary keratinization of skin epithelium. An occasional small cyst was seen on the external surface of the cornea, owing to cystic degeneration of a superficial cell. Many nuclei appeared shrunken, and some cells were devoid of nuclei. Others appeared opaque, and their nuclei were pale and faintly stained. The intercellular spaces were widened, and coagulated fluid was occasionally seen in them.

Bowman's membrane was intact, but appeared thickened in some places. Some thin-walled blood vessels were seen in the tunica propria and beneath Bowman's membrane. The fibers of the stroma were not sharply defined. The interfibrillar spaces were dilated in some places and contained coagulated fluid. There was some round cell infiltration in the anterior stroma. Descemet's membrane appeared normal. Some areas showed degenerative changes in the posterior endothelium.

The anterior chamber, in some sections, contained a fibrin network and cellular elements which were principally lymphocytes, but some leukocytes also were present. The posterior chamber contained a few similar cells.

The iris and ciliary body showed some infiltration of lymphocytes. One specimen showed large blood vessels, some of which were on the anterior surface. There were cystic spaces in the posterior layers of the iris, evidently caused by atrophy and degeneration of the uveal pigment cells.

The capsule of the lens appeared normal. In some specimens there was noted some proliferation of the lens epithelium at the equator. There was also some degeneration of the lens epithelium, manifested by swelling and dissolution of the cytoplasm and pyknosis and karyolysis of the nuclei. Many of the nuclei showed poor staining qualities. The pyknotic nuclei were often seen scattered in the débris of the degenerated lens fibers (fig. 3). Small cystic spaces, filled with coagulated fluid, were often seen between the lens epithelium and the anterior cortex.

In the anterior cortex there were seen long, narrow spaces parallel with the lens fibers, filled with coagulum. In the deeper cortical areas there was much destruction of lens fibers with the formation of coagulated fluid. In some areas the lens fibers contained many small, round vacuoles, also filled with coagulated fluid. Some of the lens fibers showed fine granular degeneration with much coagulated fluid between

the fibers. In other areas there was practically complete destruction of the lens fibers, leaving large, granular, amorphous masses of débris.

In the posterior cortex there were seen long, narrow fissures filled with coagulum. Many of the lens fibers were separated by coagulum, and some of them appeared broken down into fluid. Some morgagnian bodies were seen just beneath the posterior capsule, slightly posterior to the equator. There were also oval and round morgagnian bodies near the equator. Small, irregular spaces, filled with coagulum, were noted between the posterior capsule and the cortex.

At the equator were found swollen lens fibers with irregular outlines and a granular appearance. Some of these fibers were broken down, with the formation of morgagnian bodies. Between some of the

Summary of Data Concerning the Incidence and Time of Appearance of Certain Ocular Changes in Albino Mice, Resulting from a Deficiency of Vitamin G (B_2)

Symptoms	Number of Animals Examined	Animals Affected		Time of Appearance, Days		
		Number	Per Cent	Minimum	Maximum	Average
Keratitis	47	37	79	32	76	43
Cataract	47	45	96	35	84	48
Ophthalmia	47	27	57	36	72	50

new lens fibers there were some spaces filled with coagulum. There were some degenerated nuclei in this area, and some of them were seen in pools of coagula from the broken-down lens fibers.

SUMMARY

Young albino mice, from 14 to 16 days of age and weighing from 6 to 9 Gm., were placed on a diet entirely adequate in every dietary need except for vitamin G, which was wholly withheld. Weekly gross and ophthalmoscopic examinations were made. Histologic sections were made from the eyes of about half the experimental animals. Of forty-seven animals under experimentation, 79 per cent showed keratitis after an average of forty-three days on the deficient diet. Cataract was seen in 96 per cent of cases after an average of forty-eight days, and ophthalmia in 57 per cent after fifty days. It would appear that the deficiency of vitamin G was the sole cause of the keratitis, cataract and ophthalmia observed.

Dr. F. H. Rosebrough of San Antonio, Texas, examined some of the histopathologic sections in this study.

Clinical Notes

AN INEXPENSIVE TELESCOPIC SPECTACLE

HARRY EGGERS, M.D., NEW YORK

Although telescopic or magnifying spectacles have been manufactured by Carl Zeiss for the past twenty years, and have been prescribed by ophthalmologists whenever required, an optometrist in New York who recently made a slight modification of dubious value created a furor, especially among the newspapers. The presumably conservative *New York Times* led in the wild acclaim, publishing a large photograph of the "inventor."

The Zeiss telescopic spectacle is essentially nothing more than an improved opera glass in which, by using very high powers the two component lenses have been brought much closer together, thereby making the instrument shorter and less heavy, and thus wearable in a spectacle frame. Opera glasses are constructed according to the principle of the galilean telescope. In Galileo's telescope (fig. 1), the light rays from the object that is being viewed first traverse a convex lens and are converged to form a diminished inverted image. However, before the object rays can form the image, they must pass through a second lens which is concave and diverges them to form an enlarged virtual image. Galileo's telescope is shorter than other types of telescope of equal magnifying power; also, its image is erect. These two facts have caused its principle to be used in the construction of opera glasses. The field of view, unfortunately, is small, and this constitutes an objection to this form of magnifying device.

Telescopic spectacles are of value only to a limited number of persons with greatly decreased visual acuity which cannot be improved enough by ordinary lenses to enable them to read or to see sufficiently in the distance. By giving an enlarged image, a telescopic spectacle may enable such person to read and to view motion pictures or similar distant objects. An enlarged image gives the impression of abnormal nearness to the object. This is a psychologic phenomenon and is unavoidable. For this reason it is difficult for a person wearing telescopic spectacles to judge distances, and such a person is advised not to wear them while walking.

Because of the recent publicity in the newspapers and on the radio the public has become greatly interested in telescopic spectacles. The Zeiss spectacles cost between $50 and $60, a price that is prohibitive to many during this period of economic distress. This fact led me to devise a simplified telescopic system which any optician can make and sell for from $15 to $20.

Two ordinary flat lenses, 42 mm. in diameter, one a plus 5 diopter sphere and the other a minus 10 diopter sphere, constitute the telescope.

The planes of the two lenses are separated by a distance of 9.2 cm. The convex lens is farthest from the eye, while the minus 10 lens is directly in front of the eye. This combination gives a magnification of 2 times for distance, which is greater than the 1.8 magnification obtained with the Zeiss system. The latter, however, gives a larger field. For reading, as in the Zeiss system, a plus sphere (plus 4, 6, 8 or 10 diopters) must be added immediately in front of the object lens. The most useful addition is the plus 8 diopter lens. This increases the magnification over that of the distance system 2 times. A plus 4 diopter lens does not increase the magnification beyond the amount provided by the distance system. A plus 6 diopter reading addition increases it 1.5 times; a plus

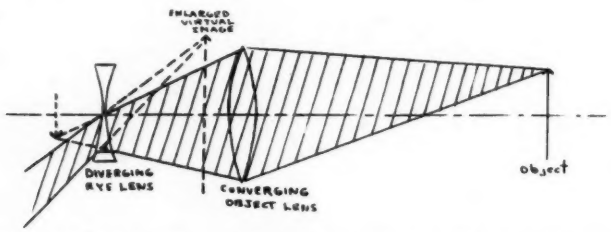

Fig. 1.—Schematic representation of a galilean telescope.

Fig. 2.—Spectacle partly folded.

10 multiplies it by 2.5. Thus, with a plus 8 diopter reading addition, in the Zeiss system a magnification of 1.8 times 2, or 3.6 times, is obtained; in my proposed combination a reading magnification of 4 times is obtained. One important advantage of my combination over that of Zeiss is the considerably increased reading distance that is obtained. In the Zeiss system with a plus 8 reading addition, the reading distance is about 12 cm. from the eyes. This is uncomfortably close. In my combination, it is about 21 cm. Another advantage for reading is the greater (about 1 cm.) leeway in bringing the print into focus. With the Zeiss telescope, the slightest motion—as little as 0.25 cm.—closer or farther throws the print completely out of focus.

Telescopic lenses cannot be purchased directly by patients. Refraction must first be done to determine the best correction for distance.

This is then combined with the minus 10 diopeter lens next to the eye. In other words, the lens directly in front of the eye consists of a minus 10 diopter sphere combined with the patient's ametropic correction for distance. The oculist should also order the proper reading addition. Only one eye can be used for reading, as the reading distance is too short to permit convergence.

Aitchison and Company, opticians in New York, have aided me in the construction of a simple, inexpensive frame which can be folded up and conveniently carried in a small pocket case. Any optician can easily duplicate it. Aitchison and Company are prepared to retail a complete telescopic spectacle, for distance and reading, for about $15 to $20. The construction is as follows (fig. 2): An ordinary gold-filled frame is used. An extension arm, with a hinge in the middle to make it collapsible, is attached to each temporal hinge or end-piece. This enables the front lenses to be folded up against the rear, and thus the spectacle may be carried in a pocket case. The extension arms are of such length that the plane of the front lenses is 9.2 cm. away from the plane of the rear lenses. The two front plus 5 diopter lenses are 42 mm. in diameter, while the two rear minus lenses may be much smaller. The reading addition is added to the front lens of the eye that is to be used for reading as a hook-over attachment.

GLASSY NETWORK IN THE ANTERIOR CHAMBER

Report of a Case

JOSEPH ZIPORKES, M.D., NEW YORK

A man, 55 years of age, had had recurrent ulcers of the cornea of the right eye for eighteen years. The last attack was about two years before this report was written.

Examination of the right eye showed a moderately dense, diffuse central corneal scar. In the anterior chamber, a curious picture was present. Figure 1 shows this to be a spiderweb-like glassy, tubular, semitransparent network, seen particularly well in retro-illumination. Branching ends of this network are attached to the posterior surface of the cornea, and all except one have an oval or circular attachment. This one is drawn out to a fine point. There are a few brown pigment dots in the lumen of two of the lower branches near their attachment to the cornea; other dots are seen scattered on Descemet's membrane about the end of the lower nasal branch. Figure 2 shows this network to be in the anterior chamber at distances varying from about 0.25 to 0.75 mm. back of the cornea. Some pigment spots, present on the capsule of the lens, are the remaining evidence of an old iritis.

The general examination and laboratory tests did not reveal any data relevant to the condition herein described.

Presented before the Ophthalmologic Section of the New York Academy of Medicine, March 19, 1933.

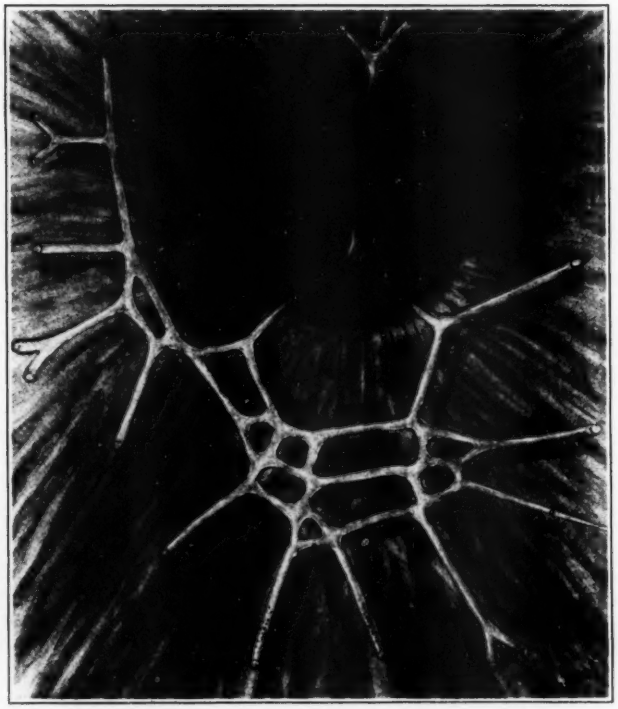

Fig. 1.—Glassy network in the anterior chamber.

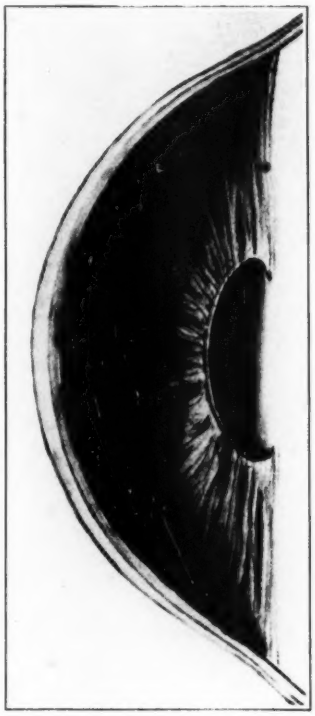

Fig. 2.—Drawing showing the distance of the network from the cornea.

COMMENT

There are two types of so-called glassy network or *Glasleisten* occurring in relation to the cornea:

1. Those which are adherent to the posterior surface of the cornea. They are not uncommon. Lehmann [1] stated that 17 per cent of the cases of syphilitic keratitis present this condition. The networks are often mistaken for folds of Descemet's membrane, and even with the use of the slit lamp it is difficult to differentiate between the two conditions.

The case of tuberculous kerato-iritis reported by Dr. Lloyd,[2] in which a "glassy membrane" was seen on the posterior surface of the cornea, apparently belongs to this group.

2. The cases showing a glassy network in the anterior chamber attached to the posterior surface of the cornea by glassy filaments. Although less common than the cases of the first group, they are not as rare as the paucity of those reported in the literature might lead one to believe. Once formed, the network or glassy ridges remain permanent.

Both types develop from a fibrinous exudate in the anterior chamber, the fibrin threads acting as a framework along which the endothelium of Descemet's membrane proliferates and secretes hyalin.

1. Lehmann: Ztschr. f. Augenh. **62**:230, 1927.
2. Lloyd, R. I.: Am. J. Ophth. **13**:753 (Sept.) 1930.

Ophthalmologic Review

ARGYLL ROBERTSON PUPIL

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The observation which made Argyll Robertson's name famous was published in two articles. The first one, twelve pages long, appeared in 1869, in the *Edinburgh Medical Journal* and was entitled, "On an Interesting Series of Eye Symptoms in a Case of Spinal Disease, With Remarks of the Action of Belladonna on the Iris and So Forth." In this paper four points were emphasized: miosis, the effect of atropine and physostigmine (eserine) on the iris, color blindness and condition of the retinal vessels. The other paper, published in the same journal, was entitled, "Four Cases of Spinal Myosis, with Remarks on the Action of Light on the Pupil." Four cases were reported. Argyll Robertson stated that "these four cases serve well to illustrate the connection between certain eye symptoms and a diseased condition of the spinal cord." As regards the nature of the spinal lesion, in one case the characters of the tabes were well marked; in the other two, the form of spinal involvement was doubtful, while in the fourth case, the symptoms of spinal disease were not well marked.

Since that time, the phenomenon which bears Argyll Robertson's name has been the subject of numerous articles and experiments. In all an attempt has been made to explain the loss of the light reflex, the site of the lesion and the cause of the miosis. The fact that many cases of unilateral Argyll Robertson pupil have been reported renders this search more interesting. My object in this paper is to review briefly the more important theories of the site of the lesion.

A REAL ARGYLL ROBERTSON PUPIL

According to Wilbrand and Saenger, a true Argyll Robertson pupil must have the following characteristics: There must be loss of the direct and indirect light reactions. The convergence reaction must be increased and sustained. The pupillary diameter should be less than 3 mm. The size of the pupil does not vary from time to time. The psychic and sensory pupillary play is lost or lessened. It must be admitted at the outset that many writers on this subject do not subscribe to this definition of a true Argyll Robertson pupil, the question of miosis being the point of disagreement. Wilson stated that miosis is incidental and is not a necessary feature of an Argyll Robertson pupil.

On the other hand, with equal assurance Behr, Lafon, Wilbrand and Saenger and many others asserted that miosis is as important as the loss of the light reaction. This is an important observation because on it depends the decision as to whether the pupil is a true or syphilitic, or a false or nonsyphilitic, Argyll Robertson pupil.

THEORIES

There are three important theories as to the site of the lesion; namely, that it is located in: (1) the spinal cord, (2) the ciliary ganglion or (3) the mesencephalon or aqueduct of Sylvius.

Spinal Cord.—Reichardt (1904) made careful studies in thirty-five cases of paralysis on the spinal cord in the zone between Goll and Burdach's columns in the upper cervical part of the cord. In all the cases of pupillary abnormalities, there was degeneration in Bechterew's midzone. On these grounds, he concluded that degeneration in this zone, especially in the third cervical segment, was the cause of pupillary paralysis, and he assumed that the Argyll Robertson pupil was a sign of disease of the spinal cord.

In 1918, Reichardt again wrote that the Argyll Robertson pupil can appear in all diffuse lesions of the cervical part of the cord, such as in myelitis, tumors or traumatism. In his opinion these regions have a direct relationship with pupillary reflex paralysis.

Wunderlich (1907) believed that a relationship existed between disease of the posterior columns and Argyll Robertson pupils, because he found corresponding lesions in his cases of Argyll Robertson pupils.

Dreyfus (1906) saw a case of miosis and fixed pupils due to an injury of the cervical part of the cord. Autopsy showed destruction of the cord up to the third cervical segment.

Brassert (1907) also believed that there is a definite pupillary center in the cervical cord. He reported a case in which Argyll Robertson pupils developed two and a half years after a fracture of two cervical vertebrae.

Seibert (1912) stated that a lesion in the upper part of the cervical cord must be responsible for uncomplicated pupillary reflex paralysis.

Redlich (1922) expressed the belief that miosis is the result of the abolition of the sensory pain impulses due to the degeneration of the posterior columns in the spinal cord.

On the other hand, several writers have found no pathologic changes in their cases.

Kinichi Naka (1905) examined the spinal cords in forty-three cases of paralysis In only one case was the cord abnormal. No special pupillary center was found in the cord. He concluded that the posterior columns, and especially the mid-zone in the upper cervical cord, have no relation to an Argyll Robertson pupil.

Bach (1906) agreed with Kinichi Naka's conclusions. In his own series of twenty-seven paralytic patients with Argyll Robertson pupils, no specific changes were found in the spinal cord. He disagreed with Reichardt.

Dejerine (1902) studied the spinal cord in his cases of Argyll Robertson pupils. No pathologic changes were seen in the cord.

The evidence is confusing. Some of these observers did not examine the brain, especially to see whether or not the floor of the third ventricle was involved.

Ciliary Ganglion.—Marina (1903) supported this theory and believed that the light reflex fibers are interrupted in the ganglion.

Thomas (1910) examined the ciliary ganglion and the ciliary nerves of two tabetic persons in whom Argyll Robertson pupils developed before death. Neither in the ciliary ganglion nor in the ciliary nerves was any pathologic process seen.

Sala (1914) studied the ciliary ganglion and roots in several paralytic patients with Argyll Robertson pupils, using the Cajal method of staining. He found that the greater part of the ganglion cells were normal. A few showed a granular homogeneous appearance of the cell protoplasm; the nuclei were distorted and were pushed toward the cell boundary. Some ganglion cells contained pigment and showed an irregular outline. The nerve fibers showed different degrees of degeneration. In the ciliary nerves were normal and degenerated fibers showing a neuritis in progress. According to Sala, an Argyll Robertson pupil is due to a slowly progressing neuritic process which attacks preferably the short ciliary nerves and is probably of a toxic nature.

Bauer (1918) believed that an Argyll Robertson pupil must be explained by a disturbance not in the centripetal but in the centrifugal section of the reflex arc. In this he agreed with Haeddaus, Levinsohn and Marina. He believed that certain pupillary fibers in the oculomotor nerve are degenerated, causing the irregular, contracted pupil.

Rizzo (1920) found no such changes in his cases.

Samaja (1921) studied the ciliary ganglions in fourteen cases of tabes and dementia paralytica in which Argyll Robertson pupils were seen. The ganglions appeared normal in all.

Bach (1906) stated that the ciliary ganglion and ciliary nerves take no part in the production of the Argyll Robertson pupil.

Wilbrand and Saenger (1922) tried to confirm Marina's findings in several cases of tabes, but in all their examinations no pathologic process was found in the ciliary ganglions.

Dupuy-Dutemps (1925) expressed the belief that an Argyll Robertson pupil is often due to a peripheral lesion affecting the neuromus-

cular apparatus of the iris. The lesion is limited to the sympathetic area of the ciliary nerve, localized in either the cells of the ganglion or the ciliary nerves.

Meriel (1926) was of the opinion that an Argyll Robertson pupil is due to incomplete paralysis of the iris itself.

Redslob (1927) agreed with Dupuy-Dutemps that all Argyll Robertson pupils show atrophy of the iris and are the cause of the pupillary reactions. The nerves in the ciliary ganglion or the ciliary nerves themselves are affected, causing the irregularities of the pupil and the loss of the light reflex. Miosis is due to an irritative lesion in the ganglion.

Dreyfus (1927) reported a case of unilateral Argyll Robertson pupil caused by a tumor of the maxillary sinus extending into the orbit. He explained this as being due to a lesion of the ciliary ganglion or the ciliary nerves going to the iris.

Lafon (1927) stated that a real Argyll Robertson pupil must show miosis and that it is always a sign of syphilis. He localized the lesion in the ciliary ganglion. The miosis is due to a hypertonus of the sphincter, and cannot be explained by an excitation of the oculomotor nucleus or by paralysis of the sympathetic.

Zis (1931) expressed the belief that an Argyll Robertson pupil with miosis is due to a disease of the sympathetic nucleus of Budge or of the ciliary ganglion. In those cases showing mydriasis, it is due to a lesion of the oculomotor nerve itself.

McGrath (1932) supported the theory of Marina.

Mesencephalon.—Bumke (1911) stated that Argyll Robertson pupils are the same size in daylight or in darkness. The loss of the light reflex comes on slowly. He also stated that the convergence reaction is stronger than the light reaction. He expressed the belief that the idea of miosis is not correct and that it should be abandoned. He and Weile stated that a true Argyll Robertson pupil was never seen in thousands of cases examined by them in which tabes or dementia paralytica was not present. Injuries to the spinal cord or the sympathetic nerves can never cause a true Argyll Robertson pupil. He also observed that at the time some of the nonsyphilitic cases of Argyll Robertson pupils were reported in the literature, the Wassermann reaction was not yet in use. Weiler's study of over a thousand cases of alcoholism did not show a single case of Argyll Robertson pupils. He concluded: "Uns ist bisher kein einziger Fall von reflektorischer Starre aus der Literature bekannt, in dem das Vorhandsein von Lues ausgeschlossen gewesen wäre." (In the literature we have so far not found a single case of reflex stiffness in which the presence of syphilis was excluded.) He did not accept the spinal cord theory. In 1881, Rieger and Forster stated that Argyll Robertson pupils were caused by diseases of the spinal cord. But in many cases of Argyll Robertson pupils the spinal

cord is normal. Injury to the cervical sympathetic nerves does not produce Argyll Robertson pupils, as shown by the work of Seibert and Harald (1912). Locker (1906) stated that injuries to the spinal cord do not produce Argyll Robertson pupils. Bach (1903-1907-1909), from his experiments on animals in sections of the medulla, could not find any loss of the light reflex. He expressed the belief that disease of the oculomotor root or any of its branches can be excluded. Either it depends on a nuclear lesion or it is due to a change which allows the sensory and motor impulses to pass through but hinders the passage of the light reflex from the sensory to the motor path. He concluded that Argyll Robertson pupil is due to a lesion of the collaterals of the centripetal reflex fibers around the sphincter nucleus. Sagittal section of the chiasm has no influence on the light reflex. There is no proof that there is an intercalary neuron.

Levinsohn (1917) expressed the belief that the sphincter nucleus itself forms the starting point of the Argyll Robertson pupil and the miosis. He also was of the opinion that this nucleus has two parts: one for the light reaction and one for the convergence reaction. There are two serious objections to this theory. Why is one part and not the other one attacked? Also, how can one explain the miosis and the loss of light reflex at the same time?

Lutz (1918) wrote an excellent article on this subject. He expressed the belief that the lesion is neither in the spinal cord nor in the ciliary ganglion but in the region of the photomotor center; i. e., there is an interruption of the connection between the last afferent sensory neuron and this center, which causes loss of the light reflex. If the lesion is large enough, it interrupts the connection between the fasciculus tectobulbaris and the principal nucleus on both sides. Small lesions leave the collaterals going to the other side untouched, the consensual reaction remaining normal. Miosis is due to an interruption of the first neuron for active pupilodilatation (fibra descendens fasciculi tectospinalis). Unilateral cases of Argyll Robertson pupils do not allow localization of the lesion in the afferent side of the arc, because such a lesion causes bilateral miosis; nor in the afferent pathway, since both light and convergence fibers are together. The lesion is, therefore, not in the centers but in their vicinity. Seitz was of the opinion that there is a tract from the anterior corpora quadrigemina to the ciliospinal center. A lesion which injures the decussation of Meynert causes bilateral miosis. Seitz stated that the loss of the light reflex is due to a lesion of the fibers which go from the corpora quadrigemina to the nucleus photomotorius (fasciculus tectobulbaris), and that miosis is due to a lesion in the fibers going from the anterior corpora quadrigemina to the ciliospinal center (fasciculus tectospinalis).

Redlich (1922) believed that the lesion is in the central gray matter of the third ventricle and the wall of the aqueduct of Sylvius. The continuous bathing of the spirochetal spinal fluid causes the changes which are shown by the disturbances in the adjacent tracts. He assumed that there was a lesion near the sphincter nucleus of such nature that on one side the pupillomotor tract is interrupted, while the other tract from the occipital cortex to the sphincter nucleus is irritated.

According to him, miosis is due to the loss of sensory and psychic reactions and partly to secondary contractures and changes in the iris. He expressed the belief that the central gray matter of the third ventricle and the wall of the aqueduct of Sylvius are bathed in spirochetal spinal fluid causing changes affecting the contiguous tracts before reaching the sphincter nucleus. Lesions must be either proximal to the partial decussation near the colliculi in the nucleus or in the centrifugal part of the reflex arc. Miosis excludes a lesion of the nucleus. Moreover, sensory, painful and psychic stimuli cause no dilatation of a real Argyll Robertson pupil. This argues against a centrifugal lesion. The irregularities of the pupil are due to different degrees of innervation or to localized atrophy of the iris.

Wick (1923) expressed the belief that the pupillary fibers make a partial decussation in the chiasm. Before entrance into the sphincter nucleus, there is another partial decussation. This idea differs from that of Bumke, in that he placed this second crossing in a sharply localized place. A lesion in this second crossing causes bilateral Argyll Robertson pupils, while a break between the second partial decussation and the nucleus causes a unilateral Argyll Robertson pupil.

Spiegel (1925) attempted to solve the difficulty by studying the vestibular reflex in animals. He assumed that it is a real reflex and that the stimulus reaches the oculomotor nucleus from the vestibular nucleus by means of the posterior longitudinal bundle. The connection is an ipsilateral and contralateral one. This vestibular pupillary reflex remains after section of the optic nerve and the cervical sympathetic. Atropine or section of the oculomotor nerve abolishes it. In testing this reflex in sixteen cases of bilateral Argyll Robertson pupil, the "turn reaction" failed in eleven. In three cases it was present bilaterally and in two it failed on one side. Spiegel, from these studies in which the light and vestibular reflexes are lost, concluded that his observations showed that the lesion must be looked for at the junction of the efferent and afferent neuron, i. e., the synapse, and stated that all other theories are untenable which localize the lesion in the region of the ascending pupillomotor path.

Wilbrand and Saenger did not accept this explanation, and stated that it is still questionable whether these pupillary movements as described by Spiegel are caused by the sphincter nucleus. Moreover,

they stated that Spiegel's explanation contradicts the laws of physiology of the central nervous system. The widening of the pupil is due to a lessened tonus in the sphincter nuclei, and at the same time there is an increased tonus of the nuclei of the external ocular nuclei causing the nystagmus and lateral deviation. How can one explain the different impulses over the posterior longitudinal bundle at the same time?

Wilbrand and Saenger also asserted that the vestibular nucleus is not in direct connection with the oculomotor nucleus, but that the stimuli coming from the vestibular nucleus are mediated directly to the pontile visual center, and from here they reach the oculomotor and abducens nuclei by means of another relay station. Whether stimulation of this center causes pupillary movements is not yet proved. They rejected Spiegel's theory for these reasons.

Spiegel (1925) experimented on cats, destroying the roof of the corpora quadrigemina in the medial plane. From his studies he concluded that the central gray matter around the aqueduct is not necessary for the light reaction, and that disease in this region cannot produce Argyll Robertson pupils. He admitted that the path from the colliculi to the sphincter is hypothetic.

Gozzano (1925) studied experimentally the question of the Argyll Robertson pupil in relation to the increase of the so-called sympathetic pupillary reaction of dilatation in response to sensory, painful and psychic stimuli. This was already studied by Moeli and Hirschel. Gozzano did his work on rabbits. He showed that the pain reaction of the pupils remains after removal of the roof of the colliculi and destruction of the central gray matter. His observations speak against the explanation of the Argyll Robertson pupil as due to a disease of the central gray matter in the region of the endings of the afferent tract. Gozzano did not believe that the spinal fluid per se injures the region of the aqueduct of Sylvius. Wilbrand and Saenger stated that these experiments did not change their positions in regard to Spiegel's theory.

Behr (1925) expressed the belief that the light stimulus which causes the pupil to contract is an instantaneous one with a momentary increase in the sphincter tone coincident with a momentary decrease in dilator tone. When these two are in balance there is no further stimulus to hold the pupil contracted, and the pupil begins to dilate. Behr called this pupillary motor adaptation. It is probably due to fatigue of the nuclear region with a consequent lessening of its tone. This explains why an increase in light stimuli does not influence the pupillary action when the nucleus center is fatigued. In the case of convergence, the pupillary reactions are due to an increased sphincter tone. The sympathetic tone remains unchanged and must be overcome. For this reason the stimulus action of the convergence impulse must be stronger than the light impulse. Behr stated that a center in a fatigued

condition not responding to weak stimuli gives a greater reaction than normal to stronger stimuli. (This statement is not accepted by many neurophysiologists.) The unknown part of the path of the light reflex, according to Behr, is the cerebral connection of the afferent path with the nuclear region. In his book he adopted the idea of Groethuysen. He assumed that all the pupillary fibers of one tract enter the same nuclear region. It is known that in some animals there is a complete decussation of all optic fibers at the chiasm and again just before their entrance into the nuclear zone. Behr assumed that the same picture holds for the crossed part of the optic nerve in man. The fibers of the right halves of each retina enter the left nuclear zone and those of the left half reach the right nuclear zone. The uncrossed tracts make a central crossing just before their entrance into the nuclei. He also assumed a bilateral pupillary representation of the macula, i. e., that from one macula, stimuli are mediated to each sphincter nucleus. He did not maintain that there is a double supply of fibers; rather that there is a division of the macular fibers centrally just before their entrance into the opposite nuclei. He expressed the belief that there are two types of fibers, pupillary and visual, and that these are of different thickness. (Hess denied this as did Magitot.) The whole retina gives a pupillomotor response from the macula to the periphery in different degrees. The separation of these fibers from the visual ones takes place in the central part of the optic tract where the same retinal halves of each eye are bound together into one bundle and enter into the arm of the superior colliculi. "Mit dem corpus geniculatum hat diese Bahn nichts zu thun." (This tract has nothing in common with the corpus geniculatum.) One can only guess as to their further course. They are probably connected with the sphincter nucleus by means of an intercalary neuron. The cause of miosis is unknown. Possibly degeneration of the spinal cord may explain it, although some cases of Argyll Robertson pupils do not show any changes in the cord. Behr was of the opinion that the sphincter nucleus, the descending tract and the ciliary ganglion are intact. The lesion is probably in the connecting neuron between the nucleus and the afferent fibers ("in Bereich der Verbindungsneurone zwischen Kern und afferenter pupillenbahn zu suchen ist [is to be looked for in the region of the connecting neuron between the nucleus and the afferent pupillary fibers]"). He did not believe that a true Argyll Robertson pupil is seen in multiple sclerosis, encephalitis, injuries to the cervical cord or alcoholism. These are probably due to some change in the central sympathetic tract plus an increased tone in the nucleus of the third nerve. In injuries of the skull, pseudoreflex paralysis occurs. Behr did not accept Levinsohn's idea of two parts to the nucleus, one for

light and one for convergence. He expressed the belief that the spirochetal toxins have a special affinity for the connecting neuron, producing the Argyll Robertson pupillary picture.

Spiegel, 1928, stated that any theory which explains the Argyll Robertson pupil must explain all of its peculiarities. The attempt of Sala and Marina to locate the lesion in the ciliary ganglion and ciliary nerves is not correct, since it must explain the selective action involving only the nerve which supplies the sphincter. It is known that paralysis of the oculomotor endings by atropine leads to an absence of the light reflex earlier than the loss of the convergence reaction, and the latter is more resistant than the vulnerable light reflex, for this can be abolished by a lesion outside of the reflex arc, i. e., by cross-section of the posterior longitudinal bundle. Spiegel rejected the theory of Bumke that there is a selective injury to the scattered endings of the optical reflex collaterals about the cells of the sphincter nucleus. The other theory, that there is a degeneration in the region of the central gray matter which affects the coursing fibers running near the aqueduct (von Monakow, Marburg, Behr and Wilson and Redlich), is not supported by the study of specimens of these regions. He quoted the work of Warkany, who examined the central gray matter around the aqueduct and the nucleus of the third nerve. In the region of the third nerve in all the cases and near the Edinger-Westphal nuclei, there was little glial cell proliferation. The central gray matter appeared normal. In the deeper layers of the central gray matter, in which the majority of the ventral fibers running from the colliculi lie, there was no glial proliferation. Spiegel assumed that the vestibular pupillary reflex (miosis, then mydriasis and lastly hippus while the patient is being turned) arises by mediation of the labyrinthine stimuli through the posterior longitudinal bundle to the homolateral and to the crossed sphincter nucleus. He studied this vestibular reflex in cases showing bilateral Argyll Robertson pupils, and arrived at his own theory. He expressed the belief that any attempt to attribute the lesion to the reflex collaterals of the sphincter nucleus is untenable (Bumke's idea), because how could one explain the retained labyrinthine action on the external muscles of the eye at the same time that the vestibular pupillary reflex is lost? To do so, one would have to assume that only certain fibers in the posterior longitudinal bundle are affected while others are untouched. For the same reason he criticized the idea of Wilson. The fact that the vestibular reflex is retained shows that the posterior bundle is not involved. Therefore, the degeneration around the aqueduct cannot be of much account. He stated that large injuries to the central gray matter around the aqueduct do not affect the pupillary light reflex. Moreover, such lesions are not shown by the

present technic. He also stated that in all cases of Argyll Robertson pupils there is disease of the fibers in the posterior commissure. In the experiments of Nagadaka, the light reflex was retained even after a large area of the superior colliculi and surrounding thalamus was removed. Spiegel did admit that it is possible that in the posterior commissure entering fibers from the superior colliculi may be involved and cause a loss of the light reflex. He expressed the belief that the lesion is in the synapse. He answered Behr's criticism by stating that it is not contrary to physiology for exciting and depressing impulses to reach the sphincter nucleus at the same time.

Ingvar (1928) discussed in detail the evolution of the diencephalon, and especially pointed out that the optic pathways during evolution remain on the surface of the diencephalon. He favored the idea that the phylogenetically old systems are generally to be found on the surfaces of the brain. He expressed the belief that the pupillomotor pathways are on the surface of the diencephalon. Their course is superficial from the lateral geniculate body to the anterior corpora quadrigemina. Syphilitic disorders of the brain cause an extensive meningeal subpial infiltration along the pupillomotor pathways, and these meningitic infiltrations and marginal degeneration within the basal regions of the brain cause the common pupillary disorders. No other disease except syphilis produces this marginal destruction in the surface layers of the central nervous system. All observers admit that syphilis begins as a marginal degeneration of the optic system. It is known that the pupillomotor fibers take a superficial path for a long distance at the level of the lateral geniculate body. In its cortical region this diverges and runs down medially toward the midline to the anterior corpus quadrigeminum. In apes it contains myelinated and unmyelinated fibers. Ingvar was of the opinion that this explains why pupillary rigidity sets in long before other manifestations of the disease, also why an Argyll Robertson pupil can exist without any other disturbance of optic function in vision or peripheral fields. He agreed with Behr that the lesion is due to a focus behind the central crossing of the pupillomotor fibers. This crossing is superficial in the posterior commissure immediately rostral to the anterior quadrigeminal bodies. Since the pupillomotor pathways are superficial, they can be involved in the basal subarachnoid spaces easily. Besides, syphilitic changes show a predilection for these spaces. No single focus can produce a bilateral Argyll Robertson pupil. In a unilateral Argyll Robertson pupil the focus is assumed to lie near the anterior quadrigeminal body. However, despite extensive research, no one has as yet found such a focus in this region. With the conception of the surface course, there is no need to resort to such foci. The actually existing anatomic lesions, the meningitic changes and the marginal degenerations of the optic pathways commonly seen in syphilis of the central nervous

system explain the lesions satisfactorily. Like Behr, Ingvar regarded miosis as a sign of irritation of the pupillomotor fibers in their course through the subarachnoid spaces to the center of the sphincter muscle. According to some authors, miosis is due to abolition of sensory and emotional dilatation of the pupil. Spiegel and Gozzano showed in cats in which sections of both cervical sympathetic nerves were performed and in which pupillary dilatation could only represent an inhibition of the tonus of the third nerve that destruction of the roof of the aqueduct and of the central gray matter of the anterior quadrigeminal body did not abolish the pupillary reaction to pain. This inhibition of the sphincter center produced by painful stimuli must reach the sphincter nucleus ventrally. Ingvar was of the opinion that miosis is due to a contraction of the sphincter muscle owing to an irritation of a meningitic process. In this tonically contracted muscle, the sensory impulses for dilatation cannot act. One need not consider the abolition of the pupillary reaction to pain as a sign of any lesion of the fiber pathways. The pain reaction is simply lost. In this way can the absence of the vestibular reflex in immobilized pupils be explained, as shown by Spiegel. The fibers of the spinal cord die one by one; so do the pupillomotor fibers. This explains why the Argyll Robertson pupil develops in successive stages. At first there is a slowness and retardation of the reaction to light. The pupil is not attacked as a whole or symmetrically. This explains the various shapes of the pupil and also why Argyll Robertson pupils disappear in some cases. Under treatment, the meningitic processes are changed, and the pupil may regain its normal size and its normal reaction. Ingvar believed that the Argyll Robertson pupil almost always occurs exclusively in syphilitic lesions of the central nervous system. He admitted that a real satisfactory and incontestable explanation of the phenomenon has not yet been advanced.

Wilkinson (1927) expressed the belief that the fibers in the accommodation reflex form a set distinct from those which form the afferent path in the light reflex. In his experiments in focusing pins, he showed that if accommodation is disassociated from convergence, no pupillary movement takes place. His experiments proved to him that there is a definite relation between convergence and contraction of the pupil, and vice versa. He assumed that the lesion in Argyll Robertson pupil is in the region of the aqueduct of Sylvius, and was of the opinion that reflex contraction of the pupils for light and for convergence travel by entirely different pathways.

Wilson (1928) expressed the belief that miosis is incidental, as is the irregularity and inequality of the pupil. A frequent correlated feature in the Argyll Robertson pupil is the absence of dilatation of the affected pupil on painful stimuli from the trigeminal area. He stated that it may occur in encephalitis, multiple sclerosis and tumors of the

anterior corpora quadrigemina or in the vicinity of the aqueduct. It may also arise in syringomyelia, chronic alcoholism and diabetes, and in trauma in or behind the eye. Wilson stated that light and visual stimuli are not the same and that each stimulus has a different pathway. In the optic tract the pupillomotor reflex fibers can be followed almost to the external geniculate body. They avoid this body and pass to the gray matter of the superior colliculus by the brachium. This agrees with the work of Karpus and Kreidl in 1913. They electrically stimulated this tract, causing pupillary contraction. When the anterior edge of the superior colliculus was stimulated, no reaction occurred. A bilateral section of the superior brachium caused the light reflex to disappear. They were able to produce bilateral Argyll Robertson pupils in an ape, which lasted for eight months unchanged. Wilson dismissed the objections of Ferrier and Turner (1927), who believed that the superior colliculi have no relation to the light reflex. According to Wilson, the site of the lesion in the Argyll Robertson pupil is on the afferent side of the light reflex arc, probably in the vicinity of the aqueduct where the colliculonuclear fibers may be diseased by the action of the toxins seeping through the walls of the aqueduct, injuring the nerve fibers. Miosis, according to him, may be due to the fact that the iridodilating tract on its way through the mesencephalon passes near Meynert's dorsal tegmental decussation or near the aqueduct. He added that it is also possible that paralysis of a cortical fiber tract to the third nerve nucleus removes this cortical inhibitory action, and miosis results.

Spiller (1930) discussed the Argyll Robertson phenomenon and maintained that it is a source of error to hold that the light reflex must be entirely abolished, that the abortive Argyll Robertson pupil has as much the same clinical value as the completely developed phenomenon and that preliminary stages are important. Another important point that he stressed is the condition of the optic nerves, whether atrophic or choked. He suggested that there must be a center in the oculomotor nucleus of each side that is concerned with the function of pupillary action on the same side. Such a center is supposed to be in the Edinger-Westphal group. The reaction to convergence is an associated one.

NONSYPHILITIC ARGYLL ROBERTSON PUPILS

Moore (1925) said that the nonsyphilitic Argyll Robertson pupil has certain characteristics. The light reflex is absent; the convergence reaction is often delayed; it is uniocular; it dilates fully in response to mydriatics, and the patient shows no evidence of syphilis. The pupil is not usually contracted.

Many have reported such cases, especially in tumors of the mesencephalon. Wilson and Rudolf reported a case of Argyll Robertson pupil in which a tumor had destroyed the anterior corpora

quadrigemina. Guillain reported a similar case with autopsy. Moeli and Buzzard reported similar cases. Fuchs (1919) reported a case of Argyll Robertson pupil due to methyl alcohol poisoning. Nonne (1919) stated that Argyll Robertson pupil may be present in chronic alcoholism, but that it is always bilateral.

The literature on encephalitis is confusing. Nonne, Economo and Dreyfus stated that Argyll Robertson pupils are often found in this disease. On the contrary, Westphal, Bielschowsky, Bumke, Adler, Behr, Cords, Genet, Mehiteus, Goldflam, Alexander, Barkan, Malling and Wilbrand and Saenger asserted that Argyll Robertson pupils are rarely, if ever, seen in epidemic encephalitis. Many cases of Argyll Robertson pupils are reported after trauma (Laedrich, Reys and Wilbrand and Saenger).

COMMENT

From a study of the literature and an examination of numerous cases of so-called nonsyphilitic Argyll Robertson pupils, one can safely say that a real Argyll Robertson pupil is always a sign of syphilis until it is proved otherwise. If one holds that the true Argyll Robertson pupil has certain definite characteristics besides the loss of the light reaction, many of these cases can be excluded because they do not come under the classification of a real Argyll Robertson pupil. In many of these reported cases, the pupils were dilated and the convergence reaction was retarded. The reason for publication of these reports was the loss of the light reflex. Most writers on this subject hold that a real Argyll Robertson pupil has certain definite features besides the absence of the light reflex, and agree with Bumke and Behr that such a pupil is always a sign of syphilis of the central nervous system.

CONCLUSION

From a review of the literature on this subject, one sees that the evidence is conflicting. Pathologic research in these cases has given little help on this subject. At the present time, few investigators hold that the lesion is in the cervical portion of the spinal cord. The theory of the ciliary ganglion as the site of the lesion is held by a few French investigators. At the present time, the majority of writers admit that the site of the lesion cannot be positively localized. The weight of evidence would seem to indicate that the lesion is in the vicinity of the oculomotor nuclei. The fact that the extrinsic muscles are often involved at the same time makes this supposition more plausible. The theory of Behr, that the lesion is in the connecting neuron which runs from the afferent pupillomotor fibers to the sphincter nucleus, is accepted by the majority of students and writers on this subject.

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Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Color Sense

DEFECTIVE COLOR VISION AND ITS HANDICAPS IN MEDICINE. L. TOCANTIN and H. JONES, Am. J. M. Sc. **185**: 243 (Feb.) 1933.

This paper deals with an investigation of seventy medical students in their third year of training to determine whether those who were color blind were materially affected in their interpretations of clinical findings. Ishihara plates were used to test color vision. Of the seventy persons who were given the test, sixty-one read the plates correctly, and nine read incorrectly two or more plates; i. e., 12.8 per cent of the group had some form of defective color vision.

The nine students with defective color vision, together with six of the students with normal color vision, were then given a series of tests as follows:

1. Titration of an unknown acid mixture, with phenolsulphonphthalein as an indicator.

2. Determination of the percentage of phenolphthalein in two specimens of urine by matching them against standards of known percentage.

3. Identification of gram-negative and gram-positive organisms in separate smears.

4. Description of the appearance of acid-fast organisms in two slides, one with methylene blue (methylthionine chloride) and the other with bismarck brown as the counterstain.

5. Identification of a polymorphonuclear neutrophil, a basophil and an eosinophil in three slides.

6. Naming of the colors of the solar spectrum as seen through a spectroscope.

The authors conclude that, since a few of the students with defective color vision made mistakes in these tests which would lead to errors in their clinical work, such persons should be discouraged from practicing medicine, or at least phases that call for accurate observation, as in the laboratory. On account of the tendency toward good discrimination of degrees of brightness, roentgenology seems an appropriate specialty for those with defective color vision.

F. H. ADLER.

Conjunctiva

RESEARCHES ON THE DIFFUSE LYMPHOCELLULAR (LYMPHOMATOUS) HYPERPLASIAS OF THE CONJUNCTIVA. C. PASCHEFF, Arch. d'opht. **49**: 497 (Aug.) 1932.

In this paper the author describes four types of diffuse lymphocellular hyperplasia of the conjunctiva, illustrating each with case reports including photographs of the patient and photomicrographs of sections of the

conjunctiva. These four types he calls (1) diffuse lympholeukemic conjunctivitis, (2) diffuse lymphomatous conjunctivitis of orbital origin, (3) lymphomatous conjunctivitis metastatic from the skin and (4) diffuse primary or simple lymphomatous conjunctivitis.

In the first form, it is a question of a solid edema the histologic picture of which shows an adenoid structure rich in lymphocytes. The blood picture in these cases is that of lymphatic leukemia. In the second type, the histologic picture is similar with marked proliferation of lymphocytes in places without the formation of follicles. The blood picture is that of aleukemia. The condition is seen in Mikulicz syndrome. In the third form the hyperplasia is symmetrically localized in the lower fornices in the form of multiple tumors. The blood picture is that of leukopenia. In the fourth type the same adenoid structure is present without the formation of true follicles. The hyperplasia may persist for years without pannus, xerophthalmia or the typical scarring of the trachoma. The process is arrested by the transplantation of buccal mucous membrane and the use of ultraviolet irradiation. The blood picture is that of a relative lymphocytosis. S. B. MARLOW.

PRIMARY POSTTRAUMATIC TUBERCULOSIS OF THE CONJUNCTIVA. P. VANCEA, Ann. di ottal. e clin. ocul. **60**: 490 (July) 1932.

The author's patient, a boy of 16, had a foreign body removed from the lower culdesac. Following this, the lid and preauricular gland became swollen, and the tarsal conjunctiva was much thickened and presented numerous small nodules, some of which had broken down and formed small ulcers. One proliferating nodule filled most of the culdesac. General examination, including Wassermann and Pirquet tests, gave negative results. In five weeks, during treatment which included excision of the large nodule and five applications of the x-rays, new ulcers continued to form. Two months later there was much improvement, but a discharging fistula had developed over the preauricular gland. Six months later the conjunctiva was almost smooth, and the fistula had healed. No lesions had developed elsewhere in the body.

Sections of the nodule showed tuberculosis with giant cells and caseation. No tubercle bacilli were found, but inoculation into a guinea-pig was positive. A bibliography is appended. S. R. GIFFORD.

Cornea and Sclera

RESEARCHES ON THE SENSIBILITY OF THE CORNEA. MARX, Arch. d'opht. **49**: 651 (Oct.) 1932.

In this paper the author presents curves obtained by touching the cornea with hairs which represent varying amounts of pressure. Each cornea is touched thirty-three times with hairs of graduated pressures. The normal experimental curve agreed closely with one computed mathematically. Curves are presented for simple glaucoma, chronic iridocyclitis, interstitial keratitis, abrasions of the cornea and herpes, all of which show a decreased sensitivity. The author believes that the construction of these curves is of great significance in the prognosis, the

diagnosis and differential diagnosis in a number of ocular conditions. He believes that they can prove of some assistance in these cases.

S. B. MARLOW.

ABSCESS OF THE SCLERA. I. A. SHARKOVSKY, Sovet. vestnik oftal. **1**: 442, 1932.

The patient, aged 81, gave the history of an injury to the inguinal region ten days previous to the onset of the ocular condition. There were edema of the sexual organs and retention of urine. The prostate was hypertrophic. There was severe pain in the left eye and left half of the head as well as general malaise and insomnia. A localized abscess of the sclera, containing yellowish-white pus, could be seen on the nasal side, 4 mm. from the limbus; the conjunctiva was necrotic in that region. There were edema of the cornea and inflammation of the iris. The fundus was seen in a haze. The leukocyte count was increased to 10,000, and there was 58 per cent hemoglobin. A broad incision of the sclera was made, followed by drainage; this led to improvement of the condition within nine days.

The author recommends early surgical intervention in abscesses of the sclera in order to insure a favorable prognosis for the local and general conditions. He reports this case as one of metastatic abscess of the sclera from the injured inguinal region.

O. SITCHEVSKA.

Experimental Pathology

IRRITANT ACTION ON THE PROTECTED EYES OF ROENTGEN AND ULTRAVIOLET RAYS DIRECTED TO DISTANT PARTS OF THE BODY. K. KIKAI, Klin. Monatsbl. f. Augenh. **88**: 478 (April) 1932.

Exposure to roentgen and ultraviolet rays is known to cause general symptoms besides the local appearances. To find the cause of this with reference to the eye, Kikai exposed the back of rabbits to varying doses of roentgen rays and to the Alpine sun lamp for varying lengths of time. Histologic examination of the eyes, which were well protected during the experiments, showed the same ocular changes as those obtained by von Szily after intravenous, intraperitoneal and subcutaneous injections of catabolic bodies.

These local ocular changes developed usually two or three weeks after the exposures, indicating that a certain length of time is required before the active substances can form by destruction of endogenous tissues. Focal infiltrations in the choroid and edema of the ciliary processes were found. Variations of the intra-ocular tension, observed by Krasso, Salinger and Thiel after exposure to roentgen rays and attributed to irritation of the sympathetic nerve, may be due to the action of parasympathetic catabolic bodies. Kikai arrived at this opinion because of the protracted effect of one exposure, because the second eye, although not exposed, showed a parallel reaction with the first and because repeated exposures produced a more distinct and more prolonged decrease of the tension.

K. L. STOLL.

General

EXPERIMENTAL STUDIES IN DIATHERMY APPLIED TO THE EYE AND ORBIT. W. F. MONCREIFF, J. S. COULTER and H. J. HOLMQUEST, Am. J. Ophth. **15:** 194 (March) 1932.

Previous experimental work is reviewed. The authors studied the effect of diathermy on forty dogs, barbital ether narcosis being used. The rectal temperature, pulse rate and respirations were taken every three to five minutes according to the variability. Current strengths of 150, 300 and 600 milliamperes were used. The results indicate that by means of diathermy it is possible (in the dog) to produce an average maximum elevation in temperature of 4.49 C. in the orbit, 6.98 C. in the vitreous, 6.54 C. in the anterior chamber and 7.11 C. in the conjunctiva in fifteen minutes. The authors discuss the experimental data and the methods used in measuring temperature. A number of tables and charts are presented.

W. S. REESE.

THE FEMALE CYCLE AND THE EYE: REPORT OF CASES. O. THIES, Klin. Monatsbl. f. Augenh. **88:** *727* (June) 1932.

Disturbances of the female cycle produce only slight or practically no changes in healthy eyes. Predisposed eyes, however, may establish a locus minoris resistentiae for the toxic action of the secretion of the endocrine glands. A belated appearance of the menses, amenorrhea, dysmenorrhea or menorrhagia is therefore likely to affect the eyes. Diseases of the eye may be premenstrual and cease with the beginning of menstruation, or they may appear during its course. Optic and retrobulbar neuritis, retinal hemorrhages, serous iritis, amblyopia and disturbances of accommodation have been observed, besides diseases of the conjunctiva, cornea and sclera. The author reports two cases of recurring edema of the lids, one premenstrual, the other occurring during menstruation, and a case of enlargement of the thyroid gland with visual and accommodative disturbances, recurring monthly at the onset of the menses for eighteen months.

A woman, aged 29, had menstruated only once when 16 years of age and once after ovarian hormones were administered a few years ago. She suffered from pluriglandular insufficiency and hypogenitalism; her vision was only 6/10 in both eyes as a consequence of optic neuritis and enlargement of the sella turcica. Amenorrhea was the first disorder noticed by this and the following patient.

A woman, aged 40, after one delivery at the age of 24 and dysmenorrhea with profuse hemorrhages for some time, had amenorrhea for two years prior to admission to the hospital in 1930. Edema and failing vision developed later on, followed by acromegaly, myxedema, enlargement of the sella, optic neuritis in the right eye and optic atrophy in the left eye. She recovered generally, and the right eye regained normal vision after two months' treatment with liver diet, thyroidin and hypophysis preparations. Being well and able to see sufficiently for her purposes for nearly two years, she had refused operative removal of the tumor of the glandular portion of the hypophysis.

Two cases are described in which bilateral recurring iritis was caused by menstrual anomalies.

The ocular changes during pregnancy, puerperium, lactation and menopause are discussed and illustrated by two cases of iritis, which, in the absence of tuberculous symptoms, were classed as climacteric uveitis. Thies closes his paper with a synopsis of the treatment.

K. L. STOLL.

General Diseases

THE OPHTHALMIC LESIONS OF BOTULISM: ADDITIONAL NOTES AND RESEARCH. C. M. SWAB and H. F. GERALD, Brit. J. Ophth. **17:** 129 (March) 1933.

This article is a further contribution by Swab, this time associated with Gerald, on the ophthalmic lesions of botulism.

The authors thus summarize their findings:

Though it is not deemed expedient to draw conclusions that are not fully supported by the present research, as some of the problems mentioned have not received sufficient consideration, the multiplicity of the lesions, together with the severe character of cell destruction and the round cell infiltration, speaks for the overwhelming virulence of the toxin of Clostridium botulinum.

This paper may be presumed to support the work of European physicians in regard to their histologic findings in the nuclei of the cranial motor nerves.

Botulinus toxin is a protoplasmic poison to peripheral nerve and striated muscle tissues, although more selective in its action on the former.

Since the toxin of Clostridium botulinum is a protoplasmic poison to peripheral nerve and to striated muscle, and since it produces marked degenerative changes in the central nervous system and also in all the tunics of the eye, it is possible and even probable that it is a general protoplasmic poison.

The theory of botulinus toxin acting as a general protoplasmic poison would explain all of the lesions herein and heretofore recorded as findings in established botulinus intoxication.

That botulinus toxin may contain a substance of exceptional resistance to heat, when judged in the main by delicate experiments on frog's nerves and muscles, is apparent from this study. More detailed work will have to be done in this field, however, before the foregoing statement can be advanced with any degree of assurance or finality.

W. ZENTMAYER.

General Pathology

MICROSCOPIC INVESTIGATION OF THE VACCINE CORNEAL REACTION IN LIVING ANIMALS. M. KAISER and P. VONWILLER, Wien. klin. Wchnschr. **46:** 38 (Jan. 13) 1933.

Since the work of Huckels, little has been accomplished in trying to solve the riddle of the Guarnieri bodies, the vaccine bodies found in the cornea of animals inoculated with vaccine lymph. Paschen's views are reviewed in detail as far as the epithelial cells are concerned. His final conclusion would seem to have been that these bodies are halos produced

by fixation methods. Studies of Burckhardt and Kobi made with the corneal microscope and slit-lamp, fluorescein being used, seem to show that the bodies are in reality caused by buckling of the epithelium with production of an exudate due to the toxic agent. The advent of the slit-lamp and ultra microscopic methods point the way of future studies. The authors have preferred to use neutral red and methylene blue (methylthionine chloride, U. S. P.) instead of fluorescein, and a reproduction of their results shown by a photomicrograph is included. Further results will be published later. A very complete bibliography is appended.

L. L. MAYER.

Glaucoma

THE INDICATIONS FOR CYCLODIALYSIS ACCORDING TO A THOUSAND OPERATIONS. DE GROSZ, Arch. d'opht. **49:** 625 (Oct.) 1932.

The author points out that the majority of operations for glaucoma are done in the chronic cases, which unfortunately are seldom seen in the beginning of the disease. Thus, in 3,725 cases seen over a period of twenty-five years, only 8 per cent were seen in the first week, 13 per cent in the first month, 21.7 per cent in the first six months, 17.7 per cent in the first year and the remaining 37.6 per cent at the end of several years.

More than 1,000 cyclodialyses for chronic inflammatory glaucoma have been done. In 87 per cent, the immediate result was good. Three hundred cases were observed to determine the late results. Sixty-two per cent were favorable at the end of one year, 54 per cent at the end of two years and 50 per cent at the end of five years. Not a single infection or sympathetic inflammation occurred in the 1,000 cases. In the author's clinic, the operations done for the different types of glaucoma are: (1) for prodromal and acute glaucoma, iridectomy; (2) for chronic inflammatory glaucoma, cyclodialysis or trephining; (3) for simple glaucoma, the Lagrange operation; (4) for juvenile glaucoma, anterior sclerotomy, and (5) for absolute glaucoma, enucleation.

S. B. MARLOW.

GLAUCOMA AND MEAN TENSION. DE SAINT-MARTIN and MERIEL, Arch. d'opht. **49:** 705 (Nov.) 1932.

The frequent association of arterial hypertension with glaucoma has led to the suggestion that this disease is essentially of a vascular nature. In this paper the authors present the results of a study on twenty-two consecutive cases of glaucoma by means of the new oscillometer of Boulitte. Although there is a great variation in the blood pressure in these cases, the authors hoped to show by means of the average pressure that there is a widespread vascular disorder. Ten cases fell definitely in the group I of Gomez, their minimum pressure being definitely determinable. In the remaining twelve, it was not possible to determine with certainty the minimum pressure. They found the average pressure to be very variable and were unable to draw any definite conclusions in regard to the average tension, except to say that in the ten cases in which the average tension was elevated, the maximum pressure was high in seven and the minimum in three.

S. B. MARLOW.

Hygiene, Sociology, Education and History

NATIONAL EYE SERVICE ADMINISTERED BY THE NATIONAL OPHTHALMIC TREATMENT BOARD (N. O. T. B.). Brit. M. J. (suppl.) **1**: 49 (Feb. 18) 1933.

In 1927, the British sight-testing opticians applied to the government for statutory registration. When this was opposed by the British Medical Association, its representatives were informed that, while the patients' best interests were subserved by examination by an ophthalmologist, yet statutory recognition could not be withheld unless an ophthalmic medical service for the poorer classes at a cost compatible with their economic status was organized. Feeling that the whole principle of statutory recognition of nonmedical persons giving medical services was at stake, the National Ophthalmic Treatment Board with equal representation on it of members of the British Medical Association and of the Association of Dispensing Opticians was formed in 1929.

Persons eligible for this service are: (1) all state-insured persons and voluntary contributors, (2) their dependents and (3) noninsured persons unable to make their own arrangements with an ophthalmologist and whose total family income does not exceed $1,250 per year.

The fee payable to the ophthalmologist is $2.50 and includes a refraction under a mydriatic when indicated, as well as such advice or operative treatment as can be given at a single consultation. When glasses are ordered, the whole charge for them, including the examination, begins at $3.50.

Persons eligible for this service go to the nearest center (in charge of the dispensing optician) and are shown a list of the board's ophthalmologists. The patient makes his own selection. The patient then brings an official prescription card to the ophthalmologist. If glasses are required, the patient brings this card back to the optician. If medical treatment alone is necessary, the doctor sends the card back to the optician. In all cases, receipt of this card is necessary before the ophthalmologist is reimbursed.

As an example of this service, out of 120 patients seen by one practitioner, 117 would undoubtedly have gone to a hospital or to a sight-testing optician. Six were admitted to a hospital and 80 needed treatment in addition to glasses. Had these patients gone to a sight-testing optician, they would undoubtedly have been given only glasses.

At present there are over 300 National Eye Service Centers in the British Isles.

W. F. DUGGAN.

ON THE PREVENTION OF OCULAR INJURIES IN INDUSTRY. G. GIUFFUDA, Ann. di ottal. e clin. ocul. **60**: 498 (July) 1932.

The author reports the reduction in frequency of ocular injuries in a health department under his supervision by the use of protective glasses and by education in the value of their use and in the necessity of prompt attention to foreign bodies and slight accidents to the eyes.

S. R. GIFFORD.

Injuries

CONCERNING MAGNETIC INTRAOCULAR FOREIGN BODIES AND THEIR REMOVAL. F. H. VERHOEFF, Am. J. Ophth. **15:** 685 (Aug.) 1932.

The reason that flying missiles strike the pupillary area far less often than some other part of the cornea is that the pupillary area is much smaller than the total remaining area of the cornea.

Holes in the iris are best discovered by throwing the light through the pupil, thus illuminating the iris from behind. In invisible perforation of the sclera, the presence of blood in the vitreous calls for a roentgenogram.

If the large magnet placed in front of the cornea fails to bring the foreign body forward, then a roentgenogram is needed for localization. Attempts to dislodge a foreign body by means of the magnet should not be abandoned until after they have been made on at least three successive days.

The author accepts the teaching of Haab that the safest way to remove a magnetic foreign body from within the eye is through the anterior chamber. Because of the greater danger of subsequent detachment of the retina, the posterior route should never be used, unless it is impossible to bring the foreign body from behind the lens, or there is a large open wound of the sclera.

Detailed description of the author's technic of bringing the foreign body into the anterior chamber is given. Its removal from the anterior chamber is effected through a keratom incision placed below and as far back from the limbus as is safe. When a foreign body lodges in the lens, both the foreign body and the lens should be removed at the same operation performed after the resulting cataract prevents useful vision.

In the few cases in which the anterior route is inadvisable, if the wound in the sclera is large and still open, the foreign body is removed through it, otherwise an incision is made elsewhere. If a foreign body is encysted far back in the fundus, its removal should not be attempted until it begins to cause deterioration of the vision.

Many other points in the technic of removal of foreign bodies from within the eye are discussed.

W. ZENTMAYER.

TOLERANCE OF A FOREIGN BODY IN THE CILIARY BODY. C. TIRELLI, Ann. di ottal. e clin. ocul. **60:** 509 (July) 1932.

A workman was struck in the eye by a foreign body. Examination by a physician revealed "conjunctival hyperemia." Three months later the vision began to decrease, but an oculist failed to suspect a foreign body. Eight months after the accident, the author found scars of a perforating wound in the cornea and iris and marked siderosis of the lens. A roentgenogram showed no foreign body. The author concludes that a piece of steel must have been lodged in the ciliary region and produced siderosis of the lens, with no other damage to the eye.

S. R. GIFFORD.

INJURY OF THE ORBIT WITH AN INDELIBLE PENCIL. G. G. ABDULAEFF, Sovet. vestnik oftal. **1:** 492, 1932.

The author states that his is the sixth case of this type of injury of the orbit reported in the literature. The unusual feature of this case was the violet-stained saliva during all the time of observation.

The patient, aged 31, was hit with an indelible pencil in the internal angle of the left eye a month previous to the examination. The lower lid was swollen, and a small tumor of semisolid consistency could be palpated deep in the orbit. A small fistula was present from which serous violet-stained liquid was obtained on pressure. Nothing could be pressed out of the canaliculi. Roentgen examination revealed no foreign body in the orbit. The fistula was enlarged with an oblique incision, and incapsulated necrotic matter with the piece of the pencil and wood was found in the orbital fat. This was removed and a drain was inserted. The next day a severe reaction, exophthalmos and limitation of movements with displacement of the eyeball followed. The saliva and nasal discharge were stained violet. All of the acute symptoms abated within from two to three weeks, but the discharge from the fistula was observed from time to time.

The author explains the staining of the saliva as due to the absorption by the wall of the uninjured lacrimal sac from the adjacent stained tissue into the nose. The stain then passed directly from the nose into the mouth.

A detailed review of the literature of the injurious action and the pathologic action of aniline dyes is given.

O. SITCHEVSKA.

Lacrimal Apparatus

ELECTROLYSIS IN STENOSES OF THE LACRIMONASAL APPARATUS. C. CESPEDES and C. GARCIA, Rev. cubana de oto-neuro-oftal. **1:** 407 (Nov.-Dec.) 1932.

Feeling that the procedure practiced by Tripier, Desmarres and Lagrange has been unjustly discarded, the authors make a plea for the use of this method because of the excellent results obtained. A Bowman probe is covered with an insulating varnish except in the terminal 5 mm. After the probe is passed in the usual manner, the tip being engaged in the stenosis, the negative pole is attached and 3 milliamperes of current (gradually attained) is turned on for five minutes. This produces softening and partial solution of the scar tissue through the lytic action. Between applications, graduated sounds are introduced to prevent untoward inflammatory reactions. The time of successful treatment has been shortened by one half, and the necessity for operation (extirpation of the sac or dacryocystorhinostomy) has been obviated in many cases.

S. L. RHODE.

Lens

EXTRACTION OF COMMON CATARACT IN THE CAPSULE. W. STOCK, Deutsche med. Wchnschr. **59:** 281 (Feb. 24) 1933.

The author reviews in brief the history of the extraction of cataract from the time of Daviel up to the present time. For the past six

months Stock has used the intracapsular method as outlined by Elsching, with modifications. No akinesia is used and the superior rectus muscle is not held with a stay suture. The author prefers a linear incision without a flap. Thus the patient is able to close the eye at the end of the operation, and there is excellent approximation of the incised edges of the wound. In 100, or 66 per cent, of 151 cases in which the intracapsular method was attempted, the lens was removed in the capsule. Much emphasis is placed on the fact that operation is possible without the aid of an assistant because of this technic. Eight of the patients had diabetes; 7 had no complications, and 1 died of diabetic coma eight days after the operation. In 11 cases there was prolapse of the iris, and a like number of vitreous protrusion into the wound, neither of which interfered with healing. No severe infection of the wound was encountered, although there was a small hypopyon in 1 case, which disappeared in three weeks leaving normal vision in six weeks. Glaucoma developed in 1 patient following iritis. Healing occurred in the other cases without incident. An outline of the author's entire technic is included. No conjunctival cultures are made. *P-n*-butylaminobenzoate of dimethylaminotheanol anesthesia is used because of its penetrability. The capsule forceps are released as soon as the lens is tumbled, and the Daviel spoon with pressure on the lower portion of the cornea extrudes the lens. Visual acuity in 96 cases was as follows: in 30, 5/5-5/4; in 33, 5/8-5/6; in 16, 5/12-5/8; in 12, 5/24-5/12, and in 3, 2/60-5/24.

L. L. MAYER.

FURTHER HISTOLOGIC FINDINGS IN SENILE DESQUAMATION OF THE ANTERIOR CAPSULE OF THE LENS. A. VOGT, Klin. Monatsbl. f. Augenh. **89:** 581 (Nov.) 1932.

The author has previously reported on three types of senile desquamation of the anterior capsule of the lens, as follows: (1) The entire capsule has the same thickness and structure and the surface lamella is detached in the shape of a foil; (2) in patches, the capsule appears more or less thinned and smooth, while adjoining areas still show normal thickness, and (3) the superficial layers show leaf-shaped dissociation in both eyes.

Vogt found that several layers are detached in succession, or even at the same time, from the same spot. He discovered vacuoles in the central layers of the capsule, which gave rise to detachment of several layers simultaneously and to desquamation of isolated bulky lamellae, resembling the formation of lamellae in furnace workers. The nature of these vacuoles in the third type of desquamation, as well as whether they are the cause or a sequela of the degeneration, has not been settled. They are filled with a fluid similar to the aqueous and seem to be identical with primarily formed fissures. The processes occurring in the depth and surface of the capsule are apparently identical: disintegration and dissociation of the lamellae with secondary infiltration of aqueous. This causes the maceration of the oldest, superficial layers of the capsule analogous to the maceration of the substance of the lens fibers. The material detached by the constant friction of the iris collects at the pupillary margin, gets into the aqueous on the pupillary disk of the capsule of the lens and on the inner surface of the cornea, and

finally obstructs the circulation. The central pupillary disk of the anterior capsule is least subject to degeneration, as it is not exposed to the friction of the iris. The pupillary disk presents the same appearance in senile exfoliation and in formation of lamellae in furnace workers. The edge of the disk is frequently lifted off and protrudes into the anterior chamber, forming a receptacle for the detached shreds and for "pigment dust." Detachment of several layers of the pupillary disk, although the surface remained smooth, was observed histologically by Vogt. No explanation could be found for the fact that the posterior capsule did not undergo similar destruction although it is subject to traction during accommodation.

K. L. STOLL.

IS THE TYPICAL DETACHMENT OF THE CAPSULAR LAMELLA A RELIABLE SIGN OF THERMIC CATARACT? REPORT OF A CASE. A. W. MULOCK-HOUWER, Klin. Monatsbl. f. Augenh. **89:** 590 (Nov.) 1932.

A white woman, aged 72, had senile cataracts in both eyes, more advanced in the left. The left eye showed typical detachment of the capsular lamella in the form of a clear membrane which protruded slightly into the anterior chamber from below the nasal and inferior margin of the pupil. The edge was glaring and slightly waved, its length corresponded to one half of the pupillary circumference, and it was about 2.5 mm. wide in the center. The shagreen of the lens was otherwise normal.

The lens of the right eye, in which no similar or other abnormality was discovered, was extracted. The capsule tore during the intended intracapsular method after Elsching, so that the nucleus had to be expressed by means of a squint hook; the entire capsular bag could be removed with iris forceps. After the pupil had remained black and the anterior chamber narrow for six days, it was filled with blood suddenly on the next morning. Uneventful absorption of the blood and recovery followed; vision was one half of the normal three weeks after the operation. The striking feature, however, was the presence in the center of the pupil of a very fine clear membrane with curved edges, measuring about 3 by 4 mm., and fixed to its substratum by fine radial fibers. No vitreous hernia was seen in the anterior chamber.

The case is of interest for several reasons. The patient was a pure-blooded white woman who had lived all her life in Dutch East India (Java) with the exception of five years. Racial peculiarities of the tropics and injury can be excluded. The question therefore arises whether the heat rays of the tropical sun may have caused this bilateral formation of lamellae, similar to the thermic lamellae of furnace workers.

The author has observed that in Java senile cataract begins with a subcapsular, central opacity of the posterior cortex, followed by opacification of the nucleus; in that country cataract develops in the earlier years of life and resembles the development of thermic cataract. These people become presbyopic sooner than the average white person, and the glass-blowers show a similar tendency in this respect. The fine membrane presenting in the pupil after the operation is interpreted as a small capsular lamella which had remained attached to the zonula.

K. L. STOLL.

Methods of Examination

TUBERCULIN IN DIAGNOSIS. S. LYLE CUMMINS, Brit. M. J. **2**: 1089 (Dec. 17) 1932.

The author agrees with the conclusion which most investigators have reached, that as a test for active clinical tuberculous disease the cutaneous and intradermal tuberculin tests are too delicate and that positive reactions elicited by these methods in adults cannot be interpreted to mean active tuberculous disease. The author furthermore believes that a markedly positive reaction to either the Pirquet or the Mantoux tuberculin test has a serious significance during the first year of life, as it proves the existence of a tuberculous infection. A positive reaction in adults is, however, of little or no diagnostic significance. Cutaneous tuberculin tests, whether Pirquet or Mantoux, or of the type of *Stichreaktion* of Epstein, are reliable tests for allergy, and, by implication, for infection, but are not of much value as tests for clinically active tuberculosis in adults, nor as tests for the existence of acquired immunity. The subcutaneous tuberculin test as originally devised by Robert Koch is, of course, not applicable to persons with pyrexia, nor is it safe as a test for persons likely to be harboring lesions of the easily activated type. In all of the tuberculin tests, the subcutaneous method remains the most valuable in diagnosis. It depends on general and focal reactions, which are evidence of actual disease, and when elicited by tuberculin, may be accepted as diagnostic of clinically active tuberculosis. The main objection to it is that there is no excuse for taking any avoidable risk in the attempt to establish the diagnosis. On the whole, for purposes of diagnosis in man, the tuberculin test, in all of its varieties, is definitely inferior to the combined radiologic, physical and laboratory examinations, which have come to be the routine methods.

A. KNAPP.

THE SUBJECTIVE DETERMINATION OF THE PRINCIPAL MERIDIANS OF ASTIGMATISM BY MEANS OF THE "STAIR-CASE" PHENOMENON OF DR. CHANOZ. PONTHUS, Arch. d'opht. **49**: 644 (Oct.) 1932.

The "stair-case" phenomenon of Chanoz is elicited on a chart composed of black circles on a white background with a rotating black line. It appears most marked when this line is placed at 45 degrees to the principal meridians of the astigmatism. The diagnosis of astigmatism and the position of its axis can be accurately determined by this simple apparatus, but the kind and amount can be determined only with the trial-case. This paper deals with the test as made in white light. In a future paper the author plans to discuss the phenomenon in colored light.

S. B. MARLOW.

SOME APPLICATIONS OF DIOPHANOSCOPY. TRANTAS, Arch. d'opht. **49**: 788 (Dec.) 1932.

The usefulness of diophanoscopy in disease of the frontal sinus is illustrated by the author with the reports of five cases. In all, the usual rhinologic examination was negative, including the roentgenogram. In these cases the author discovered a new sign which consists

in the appearance of pus in the nose and throat when pressure is applied over a firm rounded mass found in the wall of the sinus. A case of hydatid cyst of the orbit is described in which when the light was applied over the cyst the illumination was concentrated as by a lens. The possible value of this method of examination in chalazion, trachoma, vernal catarrh, dacryadenitis and lacrimal abscess is pointed out.

S. B. MARLOW.

Neurology

OCULAR MANIFESTATIONS OF LESIONS OF THE FIFTH CRANIAL NERVE. C. M. HINDS LOWELL, Brit. M. J. 2:786 (Oct. 29) 1932.

The eye is innervated by the ophthalmic division of the trigeminal nerve. Afferent impulses pass via the gasserian ganglion to the pons, where some end in the chief sensory nucleus of the fifth nerve, but many fibers descend to the upper cervical segments of the cord, relaying in the substantia gelatinosa of Rolando. From these sensory nuclei, a second afferent neuron arises and decussates to form the trigeminal fillet, which passes to the optic thalamus, whence a third afferent neuron passes via the internal capsule to the cortex.

These fifth nerve fibers from the eye can be injured in any part of their course, the result being a desensitization of the eye, with loss of the corneal reflex. There seems to be no effect on ocular movements due to loss of the afferent proprioceptive muscle impulses, the chief danger being ulceration of the cornea.

Injury to any part of the path causes a loss of the corneal reflex. The author has never seen a "spontaneous corneal ulcer" develop from a supranuclear lesion, whatever its cause, but only when the first afferent neuron is affected. Furthermore, acute injury of the gasserian ganglion as in operative trauma, herpes ophthalmicus or injection with alcohol is more likely to produce a corneal ulcer than when the peripheral nerve tissues are slowly destroyed, as by a tumor.

The author has treated sixty patients with tic douloureux by injection of alcohol. While the ophthalmic division of the nerve is rarely involved in this disease, it is often desensitized by the operation.

Of the sixty patients, thirty-six had complete anesthesia of the ophthalmic branch of the fifth nerve, and in sixteen of these corneal ulcer developed. The period of greatest danger of corneal ulcer supervening is during the first fortnight following injection. After a month, the risk is very small. In only two of the twenty patients who escaped ulcer immediately after injection did ulcers develop at a much later date, and in one of these it followed a "splash of lime" into the eye.

The cause of this tendency to inflammation and ulceration immediately after injury to the peripheral fifth nerve neurons is not known. It cannot be due to irritation of the cells of the antidromic fibers, because removal of the ganglion has the same risk of corneal ulceration.

Diseases of the deeper ocular structures following injury of the ganglion by alcohol have not occurred. Herpetic eruptions occasionally occur.

Roentgen therapy on a desensitized eye causes a more acute reaction than on an eye with a normal nerve supply, producing a marked chemosis rather than a slight injection of the conjunctiva.

Also, malignant ulcers (noncorneal) seem to progress more rapidly in a desensitized area, as in the author's case of rodent ulcer involving the orbit, which progressed with devastating rapidity following the production of an anesthesia of the area.

To prevent corneal ulceration after desensitization of the eye, the author formerly irrigated the eye daily and kept it bandaged for two weeks. At present, he keeps the lid strapped down for two or three weeks and then uses an eye shield for as long again. The first sign of beginning trouble is conjunctival injection. If this persists, the lids are stitched together. If an ulcer has formed, it will be superficial and heal without leaving any opacity. If one forms, the lids are left stitched together for from four to six months.

The author feels that any tendency to corneal ulceration following corneal desensitization is not due to trauma alone; nor does he support the theory of a trophic nerve influence.

W. F. DUGGAN.

ARGYLL ROBERTSON PUPIL AS A SEQUEL OF CRANIAL TRAUMA. C. DEJEAN, Arch. Soc. d. sc. méd. et biol. de Montpellier **13:** 469, 1932.

The patient in 1915 suffered a gunshot wound in the left parietal region, with consequent right hemiplegia, for which a decompression was performed. Both pupils are now in moderate mydriasis and react to accommodation but not to light. The blood pressure of the central retinal artery, as measured by Bailliart's dynamometer, was found considerably elevated, an objective finding in cranial trauma recently emphasized by Coppez.

An Argyll Robertson pupil signifies a lesion in a certain location, which may or may not be syphilitic. The author believes that cicatrization of the cortical lesions suffered in contusion may influence deeper portions of the brain and thus, as in this case, affect the mesencephalon.

J. E. LEBENSOHN.

RELATIONS OF THE HYPOPHYSEAL SYSTEM MIDBRAIN TO THE EYE. H. ZONDEK and G. KOEHLER, Deutsche med. Wchnschr. **58:** 2025 (Dec. 23) 1932.

The authors draw attention to the ontogenetic relation of the eye and midbrain. The literature refers often to a connection between the hypophysis-midbrain on the one hand and the background of the eye on the other hand. Examples are the reports of cases of the Laurence-Biedl syndrome and the juvenile form of amaurotic idiocy of the Spielmeyer-Vogt type and the recent description by Velhagen, Jr., of two cases of familial amaurotic idiocy which showed a fatty dystrophy. This fatty dystrophy is akin, in a sense, to the changes found in retinitis pigmentosa. Variations in the picture of retinitis pigmentosa, cases which do not show the classic pigment distribution of bone corpuscles, have led to a consideration of a factor connected with this unusual distribution of pigment. In these cases a secondary pigment disturbance may be found in the entire nerve tissue and especially in the optic nerve. Thus attention is focused on the hypophysis as the seat of the disturbance. It has been shown by Smith, Allen, Hogben, Houssay.

B. Zondek and Krohn that the pars intermedia of the hypophysis produces a hormone that has something to do with pigment control. Patients with pathologic conditions of the hypophysis have often shown changes in the ocular fundus. Four cases of pigmentary degeneration of the retina are reported briefly. Two showed definite interference with hypophyseal function, in that obesity and the specific-dynamic functions were at variance; the weighty sodium chloride retention and the distribution of adiposity aided in recognizing this discrepancy. The other two cases revealed no endocrine stigmas, but one showed a tendency to sodium chloride retention with abnormally low sugar tolerance, while the other was diagnosed "endocrine depression." The authors conclude that it must be assumed that in many cases of degeneracy which affect the entire organism the retinal portion of the eye may be reached through the optic nerve from the floor and surroundings of the third ventricle.

L. L. MAYER.

Orbit, Eyeball and Accessory Sinuses

A CASE OF BILATERAL EXOPHTHALMOS OF UNKNOWN CAUSE. N. A. PLETNEVA, Russk. arch. oftal. **8:** 559, 1932.

The case reported is of unusual clinical interest because of the marked exophthalmos and the indefinite source, notwithstanding the fact that the patient was under observation for nearly twenty-five years.

The exophthalmos was first noticed in 1906, when all tests were negative and the only symptoms were, except general weakness, impotentio sexualis and a dry skin. In 1912, the patient was treated for exophthalmic goiter, with no results. In 1916, the exophthalmos had increased greatly; the right eyeball was dislocated, and the left cornea was ulcerated. Tarsorrhaphy was done on both eyes. At that time the Abderhalden test was positive with thyroid antigen. In 1918, the patient was treated in Berlin. Part of the orbital fat was removed, and histologic examination gave negative results. Radium therapy was applied, after which the exophthalmos decreased for a short time.

On examination the exophthalmometer registered 36 mm. in the right eye and 54 mm. in the left. The lids of the right eye were adherent to the eyeball. There was no vision. Through the central opening of the left lids was seen the normal cornea; vision with correction was 2/10. The optic disk was atrophic as a result of stretching. The author believes that a disturbance of the function of several endocrine glands took place.

O. SITCHEVSKA.

Physiology

THE NORMAL OCULAR TENSION AMONG CHINESE. L. PAO-HUA, Nat. M. J. China **18:** 957 (Oct.) 1932.

Four hundred and twenty eyes with normal ocular tension were measured with the tonometer. The highest normal tension was 33 mm. of mercury and the lowest, 13 mm. Although the highest normal intraocular tension among the Chinese is the same as that of European and American countries, the lowest figure is much lower. This finding,

however, is similar to that of Gjessing. The average of this finding is 4 mm. of mercury lower than that of European and American authors.

S. H. McKee.

Refraction and Accommodation

The Brown Duochrome Refraction Test. M. Jacobs, Am. J. Ophth. **15:** 313 (April) 1932.

This test is based on the fact that the eye is not corrected chromatically so that lights of different color are focused differently depending on their wavelength. Red and green are the colors used for comparison, and the test consists essentially of obtaining a lens which makes these two colors equally bright. The author describes the apparatus and technic of its use. He concludes that the accuracy and time element are about the same for the duochrome test as compared to the usual methods of refraction.

W. S. Reese.

Monocular Cycloplegia for the Control of Myopia. W. H. Luedde, Am. J. Ophth. **15:** 603 (July) 1932.

The use of monocular cycloplegia to dissociate the two eyes in near work for the control of myopia is based on Donder's observation concerning the tendency of convergence for prolonged and excessive near work to produce myopia and of the relative exemption of watchmakers.

This study has been limited to near-sighted patients with apparently progressive myopia seen in private practice. It was used in about thirty-five cases. So far the use of monocular cycloplegia has in every case checked the advance of the myopia during the period in which it was being used.

The clinical notes of a case are detailed to illustrate the practical application of the method. A bibliography is appended.

W. Zentmayer.

The Fitting of Contact Glasses. R. von der Heydt, Am. J. Ophth. **15:** 946 (Oct.) 1932.

Patients presenting mild degrees of keratoconus who can be given useful vision by ordinary lenses do not need contact glasses. In cases of extreme variation from the standard scleral curve of 12 mm., contact glasses are deemed necessary.

The author has devised a gage for measuring the height of the corneal segments of both the eye and the contact glass. The radii of the corneal part of the contact glass need not be greater than 8 mm. In order to ascertain whether the contact glass touches the cone one may interpose a fluid layer of fluorescein solution. If the cone touches, the area of contact will be unstained, surrounded by a green ring. A slight contact is not considered harmful.

After the contact glass has been inserted, it is necessary to find the weakest spherical addition to bring the visual acuity to its maximum.

This lens may be ground so that this sphere is combined with the corneal segment, or it may be worn as a spectacle.

For the treatment of ametropia an 8 mm. radius corneal curve may be considered basic with the addition of any sphere necessary to correct the ametropia.

W. ZENTMAYER.

FREQUENCY OF THE VARIOUS KINDS OF REFRACTIVE ERRORS. I. S. TASSMAN, Am. J. Ophth. **15:** 1044 (Nov.) 1932.

The cases examined during 1931 in the refraction department of the Wills Hospital, Philadelphia, are analyzed, principally with regard to the occurrence in the various age groups of the recognized forms of ametropia, the average spherical refraction in hyperopia and myopia and the relative frequency with which the various meridians of the eyes were affected in hyperopic and myopic astigmatism, as shown by the axis of the correcting cylinder. Four hundred cases of convergent strabismus were also included.

Of 10,153 patients, excluding those with aphacia and those for whom no glasses were prescribed, 5.1 per cent were emmetropic or required a correction of 0.5 diopter or less. About 66.4 per cent were hyperopic, and 17 per cent myopic. Astigmatism was present in about 68 per cent, and mixed astigmatism was found in about 3.1 per cent.

In hyperopia, an average spherical correction of from 2 to 3 diopters was encountered in greater percentage in children up to the age of 10 years; an average of 1 diopter was by far most common between the ages of 10 and 40, after which the higher corrections again increased in frequency. In the patients with convergent strabismus, a considerably higher degree of hyperopia was found to exist. In these patients also, a deviating eye nearly always revealed a larger amount of astigmatism.

Myopia was found in the usual high degrees to a certain extent in all age groups except in children under 5 years, in which group only 4 cases were encountered in 406 patients examined.

The occurrence of astigmatism in the different meridians in both hyperopia and myopia is illustrated by graphs showing the changes in each eye taking place in the various age groups.

The author emphasizes the need for careful consideration of the complaints of patients whose eyes are refracted in prescribing the glasses required.

AUTHOR'S ABSTRACT.

TWINS WITH EYE DEFECTS: AMETROPIA AND STRABISMUS. J. A. WILSON, Brit. J. Ophth. **16:** 421 (July) 1932.

The cases were seen in the course of ordinary school and other work, and, as they were ophthalmologically selected, may not meet the strict requirements of the specialists in biometrics; yet their manifestations may be of some value.

There were twelve pairs of twins. All the pairs were of like sex, and in several pairs the results of retinoscopy were alike. It is therefore reasonable to assume that one half were monozygotic twins, as it is claimed that dizygotic twins have the similarities and dissimilarities found in other members of the same families born at different times.

In the twelve pairs of twins the cases that were alike amounted to 25 per cent; the cases that were approximately alike, to 33.5 per cent, and the cases showing a difference of more than 1 diopter, to 41.5 per

cent. Five of the six children in the first group squinted; four of the eight in the second group, and one of the ten in the third group.

Fifty pairs of brothers and sisters born at different times and not related to twins were studied. The cases that were alike or showed a difference of 0.5 diopter amounted to 14 per cent; the cases approximately alike, to 16 per cent, and the cases showing a difference of more than 1 diopter, to 70 per cent. In the first group, six squinted; in the second, four, and in the third, thirty-one.

W. ZENTMAYER.

Retina and Optic Nerve

RETINITIS PIGMENTOSA AND RETINITIS PUNCTATA ALBESCENS. J. G. MILNER, Brit. J. Ophth. **16:** 418 (July) 1932.

A case of retinitis punctata albescens in a woman, 22 years of age, whose mother has retinitis pigmentosa, is recorded. There was a history of night blindness in the maternal grandmother, in the maternal great-grandfather and in two uncles. There was no consanguinity in the parents.

A case of retinitis pigmentosa is described in a girl of 17 years, a deaf mute, whose brother, also a deaf mute, aged 13 years, had an atypical form of pigmentary degeneration. There was one other sibling, the oldest, a man 23 years of age, who was unaffected and physically normal. The parents were first cousins.

The Wassermann and sigma reactions were negative in all four cases.

W. ZENTMAYER.

RETROBULBAR NEURITIS OF NASAL ORIGIN. A. FEIGENBAUM and M. SALZBERGER, Folia oto-laryng. orient. **1:** 50 (Oct.) 1932.

The authors report twenty-four cases of retrobulbar neuritis. There were nineteen males and five females, and the disease occurred between 13 and 67 years of age, the average age being 33½. Seventeen cases were bilateral. Many of these cases occurred about four weeks after an epidemic of influenza. The visual fields showed central or paracentral scotomas. The blindspot was enlarged in two instances. Examination of the fundus was negative in fifteen; there was pallor in seven, papillitis in one and a small hemorrhage, together with narrowed arteries, in the remaining case.

Nine cases had definite sinus disease, while the roentgenograms were positive for sinus infection in twelve cases. Multiple sclerosis could be ruled out in all cases.

Since conservative treatment seemed ineffective, the sphenoid and posterior ethmoid cells were opened in sixteen cases. Microscopic or macroscopic pathologic changes were found in all these cases. Eight of the patients who were operated on and three on whom operation was not performed were cured.

The authors feel that an inflammatory edema plus a direct toxic effect (on the papillomacular fibers) are the causal factors. The fact that most of these cases followed influenza is offered as a reason for considering that the etiology was nasal in this particular group of cases.

W. F. DUGGAN.

DETACHMENT OF THE RETINA IN PREGNANCY, HEALED WITH IGNIPUNCTURE: REPORT OF A CASE. I. VON CSAPODY, Klin. Monatsbl. f. Augenh. **88:** 205 (Feb.) 1932.

Detachment of the retina may complicate pregnancy either as a consequence of nephrosis and nephritis, or as a complication of high myopia, occurring during pregnancy and delivery. The author discussed the latter possibility in detail. A woman, aged 20, whose right eye was convergent and amblyopic due to leukoma of the cornea, noticed flickering in her left eye in September, 1927. Myopia of 11 diopters and detachment of the retina were found. Scleral puncture freed a considerable quantity of yellowish fluid, and the retina had reattached completely two weeks later. The patient returned after three years of comfort with another detachment at the same site as the former one. Two ignipunctures were performed in August, 1930. The first yielded reattachment for three weeks only; the second was finally successful. Since then the patient had married and she had a spontaneous abortion in May, 1930. Future pregnancies were permitted with the understanding that cesarean section would have to be performed, so as to avoid excess strain. This operation proved successful in July, 1931. Scopolamine had been instilled into the left eye to offset possible miotic and damaging influences of the opiates (Bartels had reported a case of detachment of the retina caused by pilocarpine miosis). This case is proof, not only for Vogt's statement that the cure of a detachment may influence the future of a person, but also for the possibility to save budding life.

K. L. STOLL.

EXPERIENCES WITH GUIST-LINDNER'S OPERATION FOR DETACHMENT OF THE RETINA. K. WESSELY, Klin. Monatsbl. f. Augenh. **88:** 245 (Feb.) 1932.

The author published his first impression with the Guist-Lindner operation for detachment of the retina. It was practiced at the University Eye Clinic at Munich soon after its publication. The results were satisfactory, and disappointments were less frequent than with Gonin's operation, although a number of cases were unfavorable for operation. The procedure is more complicated but less dangerous than Gonin's operation, and a single operation may be successful even for large and multiple rents in the retina, because broader adhesions may be obtained between the choroid and retina. Unfit for the Guist-Lindner operation are patients with inflammatory detachment with iridocyclitis, or those in whom shrinking bands have developed in the vitreous after a previous unsuccessful operation according to Gonin's method. The best results were obtained in recent detachments in myopia, so long as the tears were not too large.

K. L. STOLL.

PART PLAYED BY THE LENS IN THE GENESIS OF RETINAL TEARS. I. VON CSAPODY, Klin. Monatsbl. f. Augenh. **88:** 783 (June) 1932.

Tears in the retina occur by disposition and mechanical action. Most of the spontaneous and a part of the traumatic detachments of the retina are caused by its rupture. Detachments of the retina after extractions

or secondary discissions of cataracts may be caused by peripheral tears in the retina. The tear is the direct consequence in discissions and the indirect result in extractions leading to incarceration and shrinking of the vitreous. Luxation and subluxation of the lens with detachment of the retina after contusions may cause peripheral tears. The lens itself may exert more detrimental, mechanical action on the ora serrata than the vitreous, because the fibers of the zonula extend into the ora serrata, where the retina is thinnest. Von Csapody reports in this connection an uneventful intracapsular extraction performed on a boy, aged 10. Detachment of the retina, which followed immediately, was attributed to the firm union between the zonula and the juvenile lens, and to the fact that the capsule did not tear when grasped by the forceps. Slight traction on the ora serrata, exerted frequently during a number of years, may also result in small tears of the retina with subsequent detachment. The specific gravity of the lens, which is higher than that of the vitreous, may have the same effect in predisposed eyes. K. L. STOLL.

FORMATION OF GROOVES ("RILLEN") IN THE RETINA AS A SEQUEL TO DEFORMATION OF THE POSTERIOR SEGMENT OF THE GLOBE: REPORT OF A CASE. I. KUGELBERG, Klin. Monatsbl. f. Augenh. **89:** 171 (Aug.) 1932.

Birch-Hirschfeld, in 1920, was the first author to describe a case of furrows in the retina; a short synopsis is given in this article. The last cases of this kind were published in R. Thiel's "Atlas der Röntgendiagnostik des Schädels und der Augenhöhle" (Berlin, Julius Springer, 1932).

Kugelberg reports a case which resembles one of W. Löhlein's (*Klin. Monatsbl. f. Augenh.* **79:** 769, 1927) in many respects, but which presents a different etiology; a short résumé of this case is appended. Kugelberg's patient, a woman, aged 43, underwent a subtotal strumectomy for exophthalmic goiter in October, 1931. Exophthalmos was noted, but Graefe's sign was absent at that time. The lids, however, were edematous a week after the operation, with a simultaneous decrease in vision. Massive edema persisted to such an extent that the patient could hardly open her eyes, notwithstanding the exophthalmos of 28 mm. (Hertel) in the right eye and 26 mm. in the left.

The fundus in both eyes, more so in the left, showed striation of alternating bright and dark lines, well defined and of about the same width as the superior temporal branch of the retinal artery. The reflex of the convex mirror showed these lines to be grooves (*Rillen*) through which the underlying strata could be recognized. The striated area extended as far as to the disk from the nasal side, and about 2 disk-diameters beyond the macula at the temporal side. A few isolated stripes were observed outside of these areas; none of them involved the disks, which showed slight edema and congestion at their upper, lower and nasal margins, but no prominence. The physiologic reflex around the fovea was missing. Objects appeared horizontally striated to the patient. This entoptic phenomenon had disappeared six weeks later, although the fundi remained unchanged, and the edema of the

lids had receded. The vision became normal after correction of the hyperopia, and the exophthalmos decreased gradually to 21 mm. (Hertel) during the following five months; the fundi appeared practically unchanged, with the exception of a diminution of the thickness of the retina. Examination of the fundus with the Zeiss-Nordenson ophthalmoscope and Henker's micro-arc lamp revealed several phenomena concerning the physiologic and pathologic refraction of the retina; they are discussed in detail. Photographs taken with long-waved red light showed a glare of the bright lines in the retina, while the interspaces appeared considerably darker. Kugelberg thinks that this observation allows the conclusion that the raised portions of the retina act as a convex cylindric lens, and the interspaces as a concave cylindric lens. The phenomenon is brought in line with Gullstrand's contention that the fovea acts as a dispersion lens, wherefore it appears darker than its surroundings.

In discussing the reflection of the limitans interna, the author refers to Vogt, who stated that a decrease of this reflection with advancing age would indicate that the change in the refractive indexes of vitreous and retina is more gradual in older persons. The temporary decrease of vision is explained by temporary involvement of the macula, which became normal again.

Physical and physiologic reasons are given as an explanation of the deformation of the globe which led to the formation of the small grooves in the retina. The edema of the lids, causing transient pressure on the anterior segment of the globe and corneal astigmatism à la règle, is considered contributory only. The question is not solved as to whether the edema was thyrogenous or whether the exophthalmos was caused by edema in the orbit. It is assumed, however, that the severe edema of the lids in preventing further proptosis of the globe led to its deformation. Compression of the posterior segment of the globe in a vertical direction was probably due to continuation of the edema of the lids as an edema of the orbit. A change of the inner layers only of the retina would explain why the grooves of the retina persist in these cases after the extra-ocular pressure has subsided. The author selected the term *Rillen* (grooves) and not *Falten* (folds) because only the innermost layers of the retina were involved. This limitation is explained by a shifting process of the fluid contents in the retina, so that the increase of its thickness can be considered compensatory to the limitation of its extension. That the retina had been edematous seems to be indicated by the slight edema of the disks.

K. L. Stoll.

Trachoma

Negative Inoculation with Bacterium Granulosis. F. I. Proctor, W. C. Finnoff and P. Thygeson, Am. J. Ophth. **15:** 206 (March) 1932.

A blind volunteer, aged 49, was inoculated in the left eye with Bacterium granulosis. This was done by the instillation of cultures in Leptospira medium into the conjunctiva culdesac, followed by moderate massage of the epithelium with a cotton applicator. This was repeated

twice daily for three days. The strain used was obtained from a boy at the Albuquerque Indian School, who had trachoma with pannus. Aside from a slight temporary traumatic reaction, no lesions occurred in the man or in a Macacus rhesus monkey which was used as a control. Two further attempts in which pooled cultures were used produced negative results. The authors believe that these failures may be due to the fact that Bact. granulosis loses its virulence rapidly.

W. S. REESE.

A GRAPHIC STUDY OF THE EARLY SYMPTOMS OF TRACHOMA. F. SCHOUSBOE, Rev. internat. du trachome **10:** 4 (Jan.) 1933.

In the absence of authentic laboratory tests for trachoma, the diagnosis thereof must rest on clinical analysis. The conjunctival changes, in the order of their appearance, are: 1. Hyperemia. The vascular anastomoses along the lower third of the palpebral conjunctiva become visible. 2. The larger palpebral vessels tend to an irregular and diagonal course. 3. Tiny red spots appear, later to be recognized as the tips of hypertrophing papillae. 4. The thickened mucous membrane at first produces a veil-like obscuration, and finally renders invisible the meibomian glands and all vascular details. The lymphoid changes consist in turn of (*a*) disseminated whitish spots, (*b*) yellowish-white or translucent grains and finally (*c*) large grains of sago. At the limbus, a grayish infiltration at first descends from the superior border for 2 or 3 mm.; then appears a row of cupulae, like insect eyes (*"ocelli"*), and later limbic grains of sago.

From a graphic study of the incidence of the various symptoms at different ages, Schousboe concludes that until the third year the diagnosis of trachoma must rest almost entirely on the conjunctival changes. Grains of sago are rarely seen before the fourth year, and cicatricial changes do not occur before the seventh year. After the third year, the examination of the limbus becomes increasingly important, and by the seventh year limbic changes are almost universal. The conjunctival modifications may completely disappear, but some residue of the limbic attack generally remains.

J. E. LEBENSOHN.

PRIMARY TRACHOMA INFECTION IN THE INFANT AND IN THE ADULT. TALBOT, Rev. internat. du trachome **10:** 42 (Jan.) 1933.

Primary infection in infancy is the rule, and the campaign of prophylaxis in endemic regions must be guided by this fact. Latent trachoma in the mother and associates transmits the infection to the nursling and infant. Trachoma in the adult is generally but an attack of superinfection on the basis of a persisting latent disease. Since, in northern Africa and the Levant, less than 10 per cent of girls attend schools, prophylactic attention must extend beyond these institutions and include infant-welfare stations and the homes as well.

J. E. LEBENSOHN.

THE NUCLEAR INVERSION OF VELEZ IN THE RELATION BETWEEN TRACHOMA AND TUBERCULOSIS. G. ROSSI, Arch. di ottal. **39:** 439 (Sept.-Oct.) 1932.

The author reviews the evidence in the literature that patients with trachoma seldom have pulmonary tuberculosis and vice versa. This has been emphasized especially by Angelucci and his school with the idea that a certain constitutional diathesis (lymphatism) in trachomatous patients prevents the development of pulmonary tuberculosis. The change in the blood described by Velez, an increase in the white cells with less than three nuclei as compared with the normal predominance of trinuclear forms when counted by the Arneth method, was noted in most tuberculous patients. The author investigated the blood of nineteen patients with trachoma and found that none showed the so-called nuclear inversion of Velez. This is considered further evidence of a different constitution in the two conditions.

S. R. GIFFORD.

INFLUENCE OF CLIMATE AND GEOGRAPHY IN THE DEVELOPMENT OF TRACHOMA. J. ROLLET and A. R. MULLER, Rev. cubana de oto-neuro-oftal. **1:** 373 (Nov.-Dec.) 1932.

Muller, in studing the incidence of trachoma in ninety-nine countries of the world, came to the conclusion that the areas involved lie between 10 and 60 degrees latitude north and between 10 and 35 degrees south, resulting in three nontrachomatous zones, arctic, antarctic and equatorial; that trachoma reaches its highest intensity in regions having a subtropical climate with a minimum amount of annual rainfall; that the climatogeographic conditions (altitude, seas, geological formation, humidity and winds) play the principal rôle in the production of the disease, while the individual factors (age, sex, race, constitution) and the social status (density of population, poverty, promiscuity, immigration, professions) act simply as secondary causative elements, being responsible for its propagation.

In the study of Spain the two authors show that their theory is correct. The provinces of Andalucia and Levante have from 9.18 to 17.77 cases of trachoma per thousand inhabitants (Márquez), in spite of the fact that this is a very rich agricultural area. However, the climate is the subtropical one of the Mediterranean, with an extremely low amount of rainfall and with frequent violent winds. In Asturias, on the contrary, where the changes of temperature are greater and the climate is humid, with a great deal of rain, the incidence of trachoma shows a percentage of but 0.38 (Márquez), despite the extreme poverty and poor hygienic conditions of the region. Not only is there a greater number of cases in the former, but the lesions are more active and the degree of contagion is more pronounced.

S. L. RHODE.

Tumors

PAPILLOMATOUS TUMOR OF THE ANTERIOR SEGMENT OF THE EYE OF A NATIVE OF THE IVORY COAST. DEPLANCHE, Arch. d'opht. **49:** 726 (Nov.) 1932.

The author presents a detailed clinical and histologic account of a case of primary papilloma of the cornea with secondary invasion of the bulbar conjunctiva. Such primary tumors are rare, and this is the first

to be reported for a considerable period of time. It developed from an injury to the cornea by a branch of a tree. The author refers to the books of Lagrange and Morax dealing with tumors of the eye. This tumor did not penetrate into the eye, although the cornea was much thinned. Morax states that primary tumors of the cornea do not occur, whereas Lagrange is of the opposite opinion. The case reported seems convincingly to support the latter.

S. B. MARLOW.

SUBCONJUNCTIVAL LIPOMA. BONNET and PAUFIGUE, Arch. d'opht. **49:** 795 (Dec.) 1932.

Because of the infrequency and incompleteness of the understanding of its pathogenesis, the authors describe a case of subconjunctival lipoma some features of which tend to throw some light on these tumors. The case reported is a characteristic example of subconjunctival lipoma. The findings at operation indicated that the tumor is independent of orbital tissue, contrary to the opinion expressed by Graefe. The observation of the authors of the presence of an aberrant lacrimal gland leads them to think that this is the probable origin of these tumors.

S. B. MARLOW.

LYMPHOSARCOMA OF THE ORBIT OCCURRING SHORTLY AFTER ENUCLEATION FOR METASTATIC OPHTHALMIA. C. GALEAZZI, Arch. di ottal. **39:** 454 (Sept.-Oct.) 1932.

A month after enucleation, in a boy 4 months old, swelling of the orbit and brow occurred. Diagnostic puncture revealed a large number of lymphocytes and lymphoblasts. Roentgen examination showed atrophy and erosion of the upper orbital margin. At operation an ill defined mass was found in the orbit and extending up onto the brow. The orbit was eviscerated. Sections showed a typical, very vascular lymphosarcoma. The child died three weeks after operation.

S. R. GIFFORD.

SPINOCELLULAR EPITHELIOMA OF THE CORNEA. H. VILLARD, C. DEJEAN and J. TEMPLE, Arch. Soc. d. sc. méd. et biol. de Montpelier **13:** 455, 1932.

Epithelioma of the cornea is rare and usually atypical. In the case reported, a vertical elevation extended from the limbus for 3 mm. over the cornea. Microscopic study, after ablation of the growth, showed epithelial lobules separated by vascular tissue; the cells were cylindric and in palisade arrangement at the conjunctival surface, becoming polygonal centrally, with degenerative changes present in the inner cells. The cells in the center of the lobules flattened and showed abortive keratinization.

These neoplasms, though corneal, generally start at the limbus. They do not penetrate but extend superficially over the normal tissue. Consequently they are probably adequately treated by simple ablation, followed by galvanocautery of the base.

J. E. LEBENSOHN.

SMALL CELL GLIOMA OF THE RETINA. SEMPE, C. DEJEAN and HARANT, Arch. Soc. d. sc. méd. et biol. de Montpelier **13:** 554, 1932.

A man, aged 67, complained of redness and pain in the eye of four weeks' duration with subsequent loss of vision. Protuberances of increasing size appeared in the temporal portion of the globe. The anterior chamber was normal, the tension normal and the vitreous opaque.

Histologic examination of the enucleated eye demonstrated a true glial tumor of the type found in the central nervous system and entirely different from the retinoblastomas of childhood. The probable origin was from the fibers of Müller. The presence of scattered polygonal cells subclassifies this tumor as an astrocytoma. Such tumors are relatively benign; they do not metastasize or recur after removal.

J. E. LEBENSOHN.

A CASE OF METASTATIC CARCINOMA OF THE CHOROID AFTER TUMOR OF THE LUNG. H. HAGIWARA, Acta Jap. Ophth. Soc. **36:** 138 (Nov.) 1932.

The patient, aged 49, had suffered for two months with pain in the left eye. The retina was totally detached, and the intra-ocular tension was 66. The eye was removed, and a short time later the patient began to cough. His cachexia increased, and seven months after the onset of the visual disturbance, he died. Autopsy revealed a primary basal cell carcinoma of the lung with numerous metastases throughout the body. Section of the eyeball presented a tumor in the lower half of the vitreous chamber; the ciliary body was separated from the sclera by the tumor formation, which was prominent and projected 12 mm. into the vitreous space and presented numerous hemorrhagic and necrotic areas. At the pars plana the tumor had perforated the vitreous membrane and extended into the vitreous. In the pars plana in the upper half of the eyeball there were two swellings which resulted from dissemination of the tumor.

A. KNAPP.

Uvea

A STUDY OF SYPHILIS IN THE ETIOLOGY OF UVEITIS. P. A. O'LEARY, Am. J. Ophth. **15:** 24 (Jan.) 1932.

The author describes the methods by which syphilis is diagnosed or excluded in cases of uveitis. In a review of 354 cases of uveitis, 21 patients, or 5.9 per cent, were found to have syphilis. Antisyphilitic treatment in these 21 cases caused material improvement of the uveitis in 33 per cent and slight benefit in an additional 28 per cent. The anterior type of uveitis responded more favorably. In 40 cases of uveitis in which syphilis was excluded, antisyphilitic treatment proved beneficial in 46 per cent, although in many cases the result was not lasting. The author considers syphilis an etiologic factor in a small percentage of cases of uveitis.

W. S. REESE.

IRIDOCYCLITIS AMONG THE CHINESE. H. T. PI, Nat. M. J. China **18:** 956, 1932.

The author studied 295 cases of endogenous iridocyclitis occurring among 12,111 patients admitted for the first time to the Peking Union Medical College during the last four years, that is an incidence of 2.43 per cent. In this series there were 117 inpatients, 152 outpatients and 37 referred from other services.

The percentage of incidence of various etiologic factors was as follows: syphilis, 25.6; tuberculosis, 31.6; syphilis and tuberculosis, 12.8; gonorrhea, 5.12; leprosy, 0.8; diabetes, 0.8; relapsing fever, 0.8; diabetes and tuberculosis, 0.8; heterochromia and tuberculosis, 0.8; herpes and gonorrhea, 0.8; tuberculosis and gonorrhea, 2.5, and undetermined causes, 17.2. The Mantoux test was strongly positive in all the cases of tuberculous iridocyclitis, and roentgen examination showed definite enlargement of the bronchopulmonary lymph glands and old pulmonary tuberculosis in nearly all of them. Focal infection through dental abscesses, tonsillitis and sinusitis was not found to be responsible in any case. The iridocyclitis was unilateral in 59.6 per cent of the cases. Fifty-nine per cent of the patients were males. The condition occurred most commonly between the ages of 21 and 51, and the most common season for its appearance was spring. The largest number of cases was seen in May.

S. H. MCKEE.

IRIDOCYCLITIS FOLLOWING TATOOING. M. ESTEBAN, Rev. cubana de oto-neuro-oftal. **1:** 414 (Nov.-Dec.) 1932.

A man, aged 21, who had received a penetrating wound in the left eye eleven years prior to examination, presented an extensive leukoma with incarceration of the iris, obliteration of the pupil and virtual obliteration of the anterior chamber. An iridotomy was done with a keratome, a satisfactory oval aperture being produced. Although the visual result was nil, there were a deepening of the chamber and a marked decrease from the former condition of hypertension, and the eye became quiet. A month and a half later, the tattooing was done. One month after discharge, the patient returned with a painful eye. There were ciliary injection, vascularization of the cornea invading the tattooed area, exudates on Descemet's membrane and, in the anterior chamber, atrophy of the iris and hypotension. Treatment proved of no avail. The eye was enucleated because of the intensity of the inflammatory reaction.

S. L. RHODE.

Vision

ON THE ILLUMINATION CORRESPONDING TO THE CORRECT MEASURE OF VISUAL ACUITY. J. BEYNE, Compt. rend. Soc. de biol. **112:** 754 (March 3) 1933.

Donders placed the limit of average normal visual acuity as one minute in the illumination of average daylight. More precise measurements have shown that this degree of visual acuity requires an illumination of 10 lux, or a brightness of 0.0008 candle power per square centimeter. Brightness should be used as an unequivocal standard, and

the author proposes that it be such as to permit the discrimination on a white field of two black elements separated by a visual angle of one minute, when the brightness of the black is zero, and that of the field illuminated by white light has a value of 0.001 candle power per square centimeter.

J. E. LEBENSOHN.

LOSS OF VISUAL ORIENTATION AFTER CATARACT OPERATION. J. DE JESUS GONZALEZ, Rev. cubana de oto-neuro-oftal. **1:** 377 (Nov.-Dec.) 1932.

A woman, aged 70, who had been blind for more than ten years and who during that time was able to get about by herself, frequently walking through the streets alone, was operated on. Both extractions were uneventful, but vision was not restored in the right eye because of a delayed infection twelve days after operation. In the left eye, visual acuity, with correction, was 8/10 and Jaeger's test type was read. Nevertheless, while wearing glasses, the patient moved about with great difficulty; she struck various objects in the room while walking and was unable to find the door, being apparently completely disoriented. When the eyes were bandaged she was again able to walk about without striking obstacles and could even find her way home in this condition. As normal adjustment was not attained in several days there was instituted a series of reeducational exercises which slowly brought about a recovery of the faculty of orientation.

After discussing the probable causes of the condition, the author sums up his findings as follows: the formation during many years of blindness of a psychologic system for orientation into which no visual elements entered; the presentation, on recovery of vision, of new impressions that were not utilizable because of amnesia of fixation, want of mental synthesis and inability of the patient to adapt herself to new psychic situations; resulting perturbations with regard to orientation (difficulties in the execution of ordinary movements), and, finally, gradual return to normal by means of reeducation.

S. L. RHODE.

Vitreous

CLINICAL AND EXPERIMENTAL RESEARCH ON THE ANTERIOR PORTION OF THE VITREOUS, ESPECIALLY AFTER INTRACAPSULAR EXTRACTION OF THE LENS. M. VANNAS, Klin. Monatsbl. f. Augenh. **89:** 84 (Sept.) 1932.

The author examined with the biomicroscope 249 eyes operated on for cataract at Elschnig's university eye clinic; 154 operations were intracapsular extractions, 120 of them simple and 34 combined with an iridectomy. Most of the examinations took place from seven to nine days after the operation, when the effect of miotics and mydriatics had usually disappeared. Enucleated human and pig's eyes were used for further research, after total or partial removal of the cornea and careful intracapsular extraction of the lens. The surface of the vitreous was found to be smooth and even with the level of the pupil; it protruded on pressure on the walls of the eye. Piercing of the center of the limiting membrane caused a prolapse of the vitreous and folds and

furrows in the membrane itself, which became thicker and more opaque than the surrounding uninjured portions. Release of the pressure to normal tension allowed the protrusion to retract to the level of the pupil; negative pressure resulted in the restoration of the secondary prolapse, unless it was too large. The limiting membrane has a great elasticity; it is slightly thinner in human eyes than in pig's eyes, and the tear occurs suddenly in every instance.

The biomicroscope showed the limiting membrane folded and forming a separation between the vitreous and the so-called retrolental space. This may be Vogt's membrana hyaloidea, the existence of which is still uncertain. After intracapsular extractions another membrane is frequently seen separating the vitreous and anterior chamber, whether or not the vitreous protrudes into it like a hernia. Vannas called it the "anterior limiting membrane." This limiting membrane was observed in eyes on which an intracapsular extraction was performed immediately after enucleation. A similar membrane never formed again in uninflamed eyes after the vitreous had been torn. Herniations of the vitreous into the anterior chamber, occurring after intracapsular extractions, are termed "simple" if the anterior limiting membrane is intact or "complicated" if it is torn. It may tear not only during the operation, but spontaneously later on. The width of the pupil and the intraocular tension have no influence on the size of the hernia. Retraction of complicated hernias may be difficult or impossible if the vitreous has become attached to the anterior surface of the iris. Infection of the deeper portions of the globe occurs more readily in complicated than in simple hernia. Inflammation may greatly increase the thickness of an intact limiting membrane after intracapsular extractions. This is illustrated by a case in which complete seclusion of the pupil developed, followed by increased intra-ocular tension and retraction of a very large hernia by shrinking of the vitreous.

The biomicroscope proved the correctness of the opinion that, after intracapsular extractions, the so-called retrolental space is not located outside the vitreous, but forms its outermost portion.

Seven cases are reported of displacement of the pupil after intracapsular extraction. They were caused by remnants of the embryonal pupillary membrane in four eyes, by complicated hernias of the vitreous in two and by impaction of the intact anterior limiting membrane in one.

K. L. STOLL.

Therapeutics

ULTRAVIOLET LIGHT IN OPHTHALMOLOGY. H. A. HILDRETH, Am. J. Ophth. **15:** 925 (Oct.) 1932.

Ultraviolet rays are a form of radiant energy occupying that part of the spectrum immediately below visible light, beginning, roughly speaking, at a wavelength of 4,000 angstrom units and ending at 2,000. The treatment of corneal ulcers is a special field of ultraviolet radiation. The author reports in detail three cases of corneal disease in which treatment was given by means of his apparatus, with a new filter providing constant, intensive ultraviolet rays.

W. ZENTMAYER.

ACETYLCHOLINE IN OPHTHALMIC MIGRAINE. C. DEJEAN, Presse méd. **40:** 1950 (Dec. 24) 1932.

In January, 1930, the author had the idea of using acetylcholine intramuscularly for the relief of scintillating scotomas. A dose of 0.1 Gm. reduced the usual three-quarter hour amblyopia to one lasting about two minutes, and the usual forty-eight hour headache did not occur. In June, 1930, the author presented to the Montpellier Society for Medical Sciences the results of treatment of two patients in five attacks. In the present paper the results of many attacks in five patients are recorded. While the drug did not prevent the occurrence of the attacks in every case, the symptoms were greatly decreased. Since the report of Pasteur Vallery-Radot in 1925 on the pathology of migraine the theory is that it is due to a spasm of the arterioles in the calcarine region. Amyl nitrite has been used with some success as an antispasmodic in migraine. Jonnesco has described a resection of the cervical sympathetics. Debrez advocates the removal of the superior cervical sympathetic together with the pericarotids. A résumé of the arterial anatomy of migraine is included. The author is greatly impressed by his results obtained from the use of acetylcholine.

L. L. MAYER.

TREATMENT OF CORNEAL ULCERS AND INFILTRATIONS WITH GOLD CHLORIDE. E. KLAUBER, Klin. Monatsbl. f. Augenh. **88:** 225 (Feb.) 1932.

The author obtained good results with gold chloride in a large number of cases of corneal ulcer and infiltrations of ectogenous origin. Five cases are briefly reported. The ulcers were carefully scraped and a 5 per cent solution of gold chloride applied, followed by an equal concentration of tannic acid. Beginning serpent ulcers yielded to this treatment, leaving scars of about the size of the ulceration. The tear sac was extirpated in advanced serpent ulcers, so as to prevent reinfection, or galvanocautery preceded the application of gold chloride. The progress of rodent ulcers was likewise stopped by impregnation with gold chloride.

K. L. STOLL.

Society Transactions

EDITED BY DR. JOHN HERBERT WAITE

COLLEGE OF PHYSICIANS OF PHILADELPHIA, SECTION ON OPHTHALMOLOGY

ALEXANDER G. FEWELL, M.D., *Clerk*

Nov. 17, 1932

LEIGHTON F. APPLEMAN, M.D., *Chairman*

DISJUNCTIVE OCULAR MOVEMENTS. DR. WARREN S. REESE.

Dr. Reese presented a case of disjunctive ocular movements in a man, aged 58. Abduction and adduction of the right eye were limited, particularly the former, though on elevation this eye diverged somewhat. The patient could converge or diverge the eyes at will, most of the movement being in the left eye. During divergence, the pupils contracted and exhibited hippus. There was also an associated movement of the eye and ear on each side.

DISCUSSION

DR. F. H. ADLER: This interesting case recalls a similar one reported by Dr. Spiller in 1927. The patient was a colored youth, about 20 years of age, who could hold his eyes straight and then allow either the right or the left eye to drift out, with the other eye maintaining fixation. I use the word drift, as it was thought at first that he accomplished this by relaxation of the internal rectus muscle. It was soon found, however, that this was not strictly correct and that he actually turned the eye out by contracting the external rectus muscle. When either eye diverged, the pupils dilated, and they contracted again when the eye was brought back into the primary position. Dr. Spiller considered that this case illustrated a reversion to type. In lower mammals the eyes have independent movement. They do not work together in associated movements, and histologically Perlia's nucleus is not seen. As one ascends the scale and comes to the animals in which the eyes are situated in the frontal plane and can be used together, one finds the first appearance of Perlia's nucleus and a close association between the movements of the two eyes. Perhaps it is not facetious to call attention to the marked voluntary movements of the ear which this man shows, which certainly represent a reversion to the quadruped.

DR. H. MAXWELL LANGDON: I have two patients, one with normal vision, a very low error of refraction, excellent muscle balance and good retinal condition. With the eyes fixed straight ahead, she can turn either eye in at will and not turn the other, and at the same time accommodate with either eye with the eyes in that position. The other patient can diverge either eye voluntarily.

PRIMARY SARCOMA OF THE IRIS REMOVED BY IRIDECTOMY. DR. WILLIAM ZENTMAYER.

Dr. Zentmayer presented a woman, aged 28, who was referred by Dr. H. C. Fulton with a diagnosis of probable sarcoma in the right eye. There had always been a dark spot on the blue iris. Two months before her visit it began to grow. The eye had not been injured, inflamed or painful. There was no family history of cancer. The left eye was congenitally amblyopic. Vision equaled 6/30.

Examination with a low power biomicroscope showed a chocolate-brown mass involving the iris in its lower outer sector, irregularly rhomboidal with a narrow triangular extension parallel to the pupillary border. It measured 7 mm. at the angle of the chamber and 3 mm. at the pupillary border. Under homatropine the pupil dilated evenly. No involvement of the ciliary body could be made out. Transillumination over the ciliary body gave negative results. The tension was 25 mm. of mercury by the Schiötz tonometer.

On Feb. 17, 1932, under general anesthesia, a keratome incision large enough to admit one blade of the scissors was made above the upper limit of the growth, and the incision was continued around the limbus to 4 o'clock. A blunt Tyrrell hook was introduced, the sphincter was engaged, and the entire mass with the iris was drawn well outside the anterior chamber and abscised. Following the operation, Dr. G. E. Pfahler gave ten roentgen treatments to the eye.

When the patient was last examined on Oct. 8, 1932, vision with a correction of —1.50 sph. —0.75 cyl., × 70 was 6/5. There was a coloboma with cleancut, curved pillars involving about one fifth of the iris. The visual field was full. The tension was 22 mm. of mercury by the Schiötz tonometer.

Dr. Perce DeLong submitted the following histologic report: "The specimen is composed of smoothly arranged elongated or spindle-shaped cells and round cells, very uniform in size. They are supported in bundles or whorls by a delicate stroma with thin-walled blood vessels. There are some melanin and iris pigment scattered through the structure." The diagnosis was mixed cell sarcoma.

DISCUSSION

DR. G. E. DE SCHWEINITZ: That a sarcoma of the iris, provided it is small and in an early stage, can be removed successfully by a broad iridectomy is well known. In such circumstances this operation has received the sanction of a number of ophthalmic surgeons who write, or have written, with authority, for instance, Ernest Fuchs and Salzmann. Dr. Zentmayer's interesting report again demonstrates the availability of this operative procedure.

On the other hand, other authors, for instance, Brown Pusey and Wood, have been emphatic in their advice that the globe shall be enucleated as soon as the diagnosis is satisfactorily established.

I have not, personally, had the opportunity of removing a sarcoma of the iris by means of iridectomy, but in two instances, in consultation with the surgeons in charge and in agreement with their recommendation, I advised excision of the growth. This operation was performed, and

although a number of years have elapsed, so far as I am aware there has never been any recurrence or metastasis. In a third case I recommended a similar procedure, but I am unaware of the subsequent history.

BULLOUS KERATITIS SUCCESSFULLY TREATED BY IRIDECTOMY. DR. WILLIAM ZENTMAYER.

Dr. Zentmayer presented a man 71 years of age on whom he had performed an iridectomy in April, 1931, for relapsing bullous keratitis of the right eye. The eye had remained quiet and the epithelium in place since then. In October, 1931, the left eye became similarly affected. Despite local treatment the blebs recurred, and in January, 1932, an upward iridectomy was performed. After six weeks no further bullae developed. Both lenses showed exfoliation of the anterior capsule and both corneas showed dystrophy of the endothelium. Only in the right eye was the tension in the least elevated at any time. The corneal condition was not due to glaucoma or to iridocyclitis but was probably brought about through the action of toxins on the endothelium, breaking down the barrier to the passage of aqueous through the corneal lamella, which resulted in the elevation of the epithelium. The decision to perform iridectomy was based on empiricism, the thought being that the circulation of the fluids of the eye, and consequently the metabolism of the cornea, would be improved by the operation.

DISCUSSION

DR. F. H. ADLER: This patient came to the Wills Hospital and was seen in Dr. Baer's clinic. I did not consider his condition bullous keratitis, although that is the diagnosis on the record of the clinic. Since my attention was centered largely on the peculiar changes in the anterior capsule of the lens which one could see with the slit lamp, somewhat resembling zonular lamella, I believed that he had either glaucoma lenticulocapsulare or endothelial dystrophy. The changes in the capsule of the lens plus the tendency to a slight rise in pressure led me to believe that the condition was this type of glaucoma, which has recently been described by a number of German clinicians. At the same time, the marked changes on the endothelial surface of the cornea suggested the diagnosis of endothelial dystrophy. We did not consider performing an iridectomy, as the tension was only slightly elevated. Although I was not particularly struck by the bullous character of the corneal lesion, the record shows that bullae existed. Whatever the condition was, the iridectomy which Dr. Zentmayer performed was successful in clearing the cornea.

A NEW TECHNIC FOR THE PREPARATION OF PATHOLOGIC SPECIMENS FOR MICROSCOPIC STUDY. DR. PERCE DELONG.

This article appeared in full in the June, 1933, issue of the ARCHIVES, p. 976.

DISCUSSION

DR. W. E. FRY: I think that the point that is to be emphasized in regard to this method is the greater rapidity with which specimens can be prepared, because by other methods it is impossible to get very thin sections.

ONE HUNDRED INTRACAPSULAR EXTRACTIONS OF CATARACTS BY THE KNAPP METHOD. DR. LEIGHTON F. APPLEMAN.

This article appeared in full in the June, 1933, issue of the ARCHIVES, p. 907.

DISCUSSION

DR. LUTHER C. PETER: There is a question as to what method of intracapsular extraction will eventually prevail. The Smith method is a simple one to follow when one cannot remove the cataract in the capsule or by any other method. The capsule forceps will probably be used by a great majority of surgeons. My experience leads me to believe that the Barraquer method is best. One must select patients carefully. For young patients with immature cataracts it is better to use one of the three smooth forceps. For patients of 60 years or older, it is safe to use a suction apparatus. If one is careful to apply the erisophake squarely to the lens, one rarely fails to deliver the lens if the patient is 60 years of age or older. One can obtain a good grip on the sclerosed lens with an erisophake when it is impossible to get a good bite with the forceps.

DR. GEORGE CROSS: One difficulty in attempting to rupture the suspensory ligament with the Kalt forceps is the tendency to pull the lens toward the incision, which often ruptures the ligament. This is corrected by downward and forward traction against the counterpressure on the outside, which ruptures the ligament below, as is desired. To me a most interesting step in the operation is the application of the forceps and their manipulation. It seems that some failures to get hold of the capsule properly are due to the fact that the incision is not made sufficiently large. In this operation it is essential to enlarge the incision so that the capsule forceps can reach over the center of the curve of the lens, without too much trauma to the cornea. I never perform an extraction in the capsule without using an aluminum shield for three days after the operation, until the first dressing, and sometimes for a few days longer, so that no accident may occur.

DR. H. MAXWELL LANGDON: Can Dr. Appleman report whether the three retinal detachments occurred in patients with a high degree of myopia?

DR. CHARLES E. SHANNON: In connection with Dr. Appleman's paper, I should like to report the complication of choroidal detachment occurring in a patient eight days after a successful intracapsular extraction. The detachment appeared to be spontaneous. Reattachment took place three weeks later, with satisfactory recovery of vision.

DR. W. J. HARRISON: I have performed, I believe, 14 Barraquer operations since June, 1931. Ten patients showed vision of 20/20; 1, vision of 20/50, and the other 3, vision of 20/30 or 20/40. In 1 case there was a loss of a drop or two of vitreous, owing to the fact that I was too anxious to get the lens out. Most of the cases were selective, and I hope some time to be able to give a more detailed report.

DR. L. F. APPLEMAN: I think that a great deal of the success of this operation depends on the patient. As is known, any considerable

movement may spoil the result. I believe that a certain amount of preliminary training on the day before is profitable. Regarding Dr. Langdon's question as to myopia, detachment did not occur in cases of myopia.

ALEXANDER G. FEWELL, M.D., *Clerk*

LEIGHTON F. APPLEMAN, M.D., *Chairman*

Dec. 15, 1932

FRACTURE OF THE MAXILLA THROUGH THE LEFT OPTIC FORAMEN. DR. H. MAXWELL LANGDON.

This article appeared in full in the June, 1933, issue of the ARCHIVES, p. 980.

DISCUSSION

DR. EDWARD A. SHUMWAY: From the character of the visual field, which is full peripherally, indicating the absence of any disturbance of the peripheral fibers of the nerve, and which shows as the important feature a large, partly absolute and partly relative scotoma situated below the center of vision, it appears that the true cause of the visual disturbance was not a fracture extending into the optic canal, but rather a hemorrhage pressing on the upper part of the optic nerve and therefore involving particularly the papillomacular fibers, which are well known to be more sensitive than the other fibers of the nerve. It would be interesting to study the color fields also, as I have observed at times, in such injuries, marked disturbance of the color-carrying fibers, the nerve becoming pale but the ultimate vision and the form field not being affected.

DR. L. F. MCANDREWS: Dr. Langdon stated that as soon as the splint was applied, the vision improved. Would not this tend to indicate that the bony displacement rather than hemorrhage was causing the poor vision?

EXTRACTION WITHIN THE CAPSULE OF THE CRYSTALLINE LENS CONTAINING A FOREIGN BODY. DR. BURTON CHANCE.

Dr. Chance, in exhibiting some lenses containing foreign bodies, briefly reviewed the management of cataract caused by the lodging of a foreign body in the lens.

The specimens were removed entire without rupture of the capsule. His method was to dislocate the lens, and with pressure from below to extract the whole lenticular body through an incision made as in the ordinary operation for cataract. In each of the cases no complication arose, healing was prompt, and the visual result was satisfactory.

SUPERFICIAL PUNCTATE KERATITIS AND THE ASSOCIATED CONJUNCTIVITIS. DR. G. E. DE SCHWEINITZ.

It was pointed out how well superficial punctate keratitis was described by Robert Wright in his study of this disease in India, where

it exists in an epidemic form. After vital staining with fluorescein, the corneal lesions are readily detected with the corneal microscope and slit lamp or, although not so strikingly, with a good corneal loupe. Dr. de Schweinitz expressed the belief that the various forms of superficial punctate keratitis are not more frequent now, i. e., within the last ten or twelve years, than formerly, but that they are merely more often detected, owing to the increasing use of the slit lamp; this point was emphasized by Meesmann.

Dr. de Schweinitz classified his cases as follows: (*a*) unilateral, with only fine, punctiform lesions, subject to relapses, first in one eye and then in the other; (*b*) bilateral, with mixed lesions varying in size from that of a pinpoint to that of a pinhead and also hook-shaped lesions; (*c*) unilateral or bilateral, with a tendency for the foci to form rows in addition to their scattered situation. Generally the lesions avoided the periphery of the cornea; direct vision was unaffected unless large lesions were implanted at the center of the cornea. In a fair number of patients who had come under observation during the past few years persistent conjunctival hyperemia had been treated for weeks and even months without relief by the usual collyria and local applications before the corneal complication was detected by the method described.

Dr. de Schweinitz recommended as the best lotion physiologic solution of sodium chloride; all irritating lotions should be avoided; a 1 per cent solution of phenacaine and a 1:1,000 oily suspension of acriflavine hydrochloride have proved to be useful. Focal infections should be eliminated; removal of the tonsils was helpful in one of the cases, and treatment for chronic ethmoiditis in two others.

DISCUSSION

Dr. Hunter W. Scarlett: Since Dr. de Schweinitz drew my attention to the close association between superficial punctate keratitis and conjunctivitis of long standing, I have been on the lookout for such cases. During the past six months I have examined eight patients with this condition, six females and two males. Their ages varied from 8 to 50 years; the average time between the onset of symptoms and the first examination by me ranged from one week to several weeks or months. Convalescence lasted for from five or six days to several weeks or months, depending on the severity of the attack; in seven of the eight patients the condition was bilateral, and in one it was unilateral, which was contrary to the finding of Wright, that bilateral cases are not often observed.

Dr. Burton Chance: I am sure that Dr. de Schweinitz can recall that Dr. Norris pointed out to him, just as he remarked to me, as far back as 1896, that not infrequently one may find superficial involvement of the cornea in low grade chronic conjunctivitis which fails to yield to the ordinary remedies.

Dr. Edward A. Shumway: In my experience unilateral persistent chronic types of conjunctivitis with corneal involvement are more likely to be associated with infection of the ethmoid sinus, although at times the only focus of infection is found in the tonsils. When the tonsils

are involved the condition is more apt to be bilateral, but in every case an exhaustive study of the entire body for foci of infection should be made.

DR. T. B. HOLLOWAY: The superficial lesions to which Dr. de Schweinitz called attention are not only extremely interesting, but at times difficult to classify properly. Two of the most typical cases of the old type of superficial punctate keratitis that I have seen were associated with uterine disturbances, and both responded after several weeks of local treatment and the correction of the uterine trouble. Dr. de Schweinitz did not allude to the corneal sensation in certain of these cases. I believe that a certain number of them are definitely neuropathic. There is an alteration in the sensation of the cornea at times, and in my experience sensation is more frequently decreased. As to the use of salt solution, one patient now under observation would use nothing else, and this has been my experience in certain other cases. In addition to this, in many of these cases a bandage is invaluable and the most important of the various therapeutic measures that could be used, but it is necessary that the dressing beneath the bandage should be thick so as to immobilize the lid completely.

METASTATIC CARCINOMA OF THE CHOROID. DR. PERCE DELONG.

Though many cases of metastatic carcinoma of the choroid have been reported, the rarity of the condition warrants the citation of any additional authentic cases. I therefore add the following case to the list already published.

For extensive and detailed study of this condition I refer the reader to the articles of Marshall, Parsons, LaGrange and Oatman. In the works published in 1932, 130 cases were reported. These, with my case and 4 cases reported by American authors which were not included in this total, bring the number to 135.

It is difficult to obtain accurate statistics on this disease, for it is reasonable to suppose that some patients in the last stages of cachexia die without the ocular lesions being recognized.

This discussion is restricted to specific cases of metastatic carcinoma of the choroid. All carcinomatous involvements of the choroid as yet reported have been metastatic, but several cases of primary carcinoma of the iris and the ciliary body have been reported. The usual seat of the primary growth (in the order of frequency) is the breasts, lungs, stomach, liver, mediastinal glands or thyroid gland. Rarer locations are the suprarenal glands, the prostate and the ovaries.

The patient in the case which I had the opportunity of studying pathologically was a white woman, aged 48, who was admitted to the Lankenau Hospital on July 19, 1932. She complained of a "boring" pain in the right eye, disturbance of vision and distortion of objects and also a sensation of flashes of light before the eyes.

General examination of the heart, kidneys and lungs gave negative results. The abdomen was soft and relaxed, and no tenderness or mass was detected. A later examination revealed a nodular mass in the upper right quadrant of the abdomen, under or attached to the liver.

There was some exophthalmos in the right eye. The pupils were equal and reacted to light and in accommodation. In the right eye,

the sclera was somewhat injected; examination of the fundus was unsatisfactory. The left eye presented normal eyegrounds. The clinical diagnosis was choroidal sarcoma of the right eye. This eye was enucleated, and the patient was discharged on July 25.

The patient returned six days later, complaining of severe, "stabbing" pain over the right lower ribs. She had no cough. She had had dyspnea since July 26 and became exhausted after speaking long sentences. Roentgen examination of the chest revealed a moderate bilateral diaphragmatic lag. There was slight haziness over the base of the left lung. There was no evidence of demonstrable sarcoma. She was discharged on August 26 and died two months later.

Macroscopic examination of the enucleated eye showed a globe of normal size, which on section revealed a shallow anterior chamber. In the posterior portion there was a flat neoplasm, of which the greater anteroposterior diameter was 3 mm. It terminated rather abruptly at the equator. The overlying retina was detached by a subretinal serous exudate. This separated the retina from the neoplasm.

Microscopic examination showed: The preequatorial section of the globe presented slight evidence of edema with secondary glaucoma, manifested by a small ciliary body and processes, which were dragged forward. There were almost complete absence of the anterior chamber and complete obliteration of the filtration angle. The retina was detached and showed evidences of disorganization and early edema.

The neoplasm was composed of tubular or adenoid epithelial cells. The arrangement of these cells was rather irregular in certain areas and in others presented a cuboidal outline. Other cells appeared globular. There were no areas of necrosis or hemorrhage. The advancing cells could be seen infiltrating in the lymph spaces of the choroid.

The stroma was composed of connective tissue with branching tuberculi. The choroidal vessels were distorted but were present in the stroma. There was some formation of vessels. Bruch's membrane was intact. The sclera was not infiltrated. There was no metastasis to the optic nerve.

DISCUSSION

DR. EDWARD A. SHUMWAY: I wish to corroborate Dr. DeLong's observations as to the carcinomatous character of the metastasis in the choroid. At the time of the original examination it was thought that the condition was a sarcoma of the choroid, and later, when the mass appeared in the liver, it was believed that this was a metastasis from the sarcoma. Microscopic examination of the specimen, however, showed the condition to be a metastasis from a glandular carcinoma of the intestine, with secondary involvement of the liver. These metastases enter the eye, as Dr. DeLong said, through the short posterior ciliary vessels, and occasionally metastases can be found in the ocular muscles in the orbit, which are also supplied by the ciliary branches of the ophthalmic artery.

DR. H. MAXWELL LANGDON: I observed a case in which the condition was probably metastatic carcinoma of the eye, with primary carcinoma in the breast. No pathologic study of the eye was possible.

Sodium Carbonate (Monohydrated) in the Treatment of Vernal Conjunctivitis. Dr. Louis Lehrfeld.

Dr. Lehrfeld advocated the use of monohydrate sodium carbonate, 5 and 10 grains (0.3 and 0.6 Gm.) to an ounce (30 cc.) of water, in the treatment of the acute stage of vernal conjunctivitis. The directions for the use of this preparation are as follows: The eyes are flushed with cold saturated boric acid solution, seven times daily, an eye cup being used. Sodium carbonate is then instilled into the eyes, 3 drops being given four times a day, always preceded by flushing with boric acid. The principle underlying treatment with sodium carbonate is that this chemical disintegrates the stringy mucus which is characteristic of the palpebral form of vernal conjunctivitis. The strength of the sodium carbonate is determined by the quantity necessary to disintegrate the mucus partially and to loosen it from its attachment to the conjunctiva. The flushings with cold boric acid solution serve to wash away the loosened mucus, and the cold lotion takes the place of epinephrine in its astringent and soothing effect. The treatment removes from the eye the exciting agents of vernal conjunctivitis, thus relieving the symptoms and encouraging the recession of the pathologic lesions of the disease.

DISCUSSION

Dr. Burton Chance: I have used sodium carbonate in profuse conjunctivitis for a number of years. I stumbled on it by accident. I use ordinary sodium carbonate in my sterilizer. One day a patient came in with a greatly inflamed eye and copious discharge; I sucked up in a pipet a quantity of water from the warm sterilizer and washed the lids. To my amazement the lids became clean, and the patient was relieved of discomfort. Since that time I have been using sodium carbonate in my ordinary cases.

Dr. Edward A. Shumway: I corroborate the effectiveness of a 1 per cent solution of sodium carbonate in the treatment of vernal conjunctivitis.

Correspondence

ANTERIOR CHAMBER PUNCTURE

To the Editor:—An extended detailed reply to P. C. Kronfeld's recent article (Anterior Chamber Puncture in Relation to Intra-Ocular Tension, ARCH. OPHTH. **9:** 801 [May] 1933) would be necessary to call attention to the many errors contained therein. To do so, however, would only further burden an already overburdened ophthalmic literature.

I must, however, point out that the data that both Kronfeld and I used were obtained from the material in the possession of the Department of Ophthalmology of the University of Chicago Clinics. The data were obtained by Kronfeld or under his direct supervision or by other members of the same staff (Dr. D. Katz, myself and others) whose findings were accepted by both of us without question. In my opinion some of these data were wrongfully ignored or misinterpreted by him. I claim that they should have been made available for the proper consideration of his so-called test.

Kronfeld has failed to present a single case to answer my challenging statement that "no cases of hypertonia after anterior puncture have been found in which clinical glaucoma, previously absent, developed after this test" (ARCH. OPHTH. **7:** 899 [June] 1932).

Kronfeld explains as an error a statement supposedly made by him almost two years after it is called to his attention, and then explains this incompletely and inaccurately. His actual statement (in discussion on Haden, H. C.: Some Observations in Regard to Glaucoma Simplex, ARCH. OPHTH. **4:** 763 [Nov.] 1930) was: ". . . I shall describe a method of detecting the early stages of glaucoma which we have used at the clinic . . . for the past two years. The method . . . so far as I know has not failed once in 200 cases. . . . This test has always proved positive in every case of definite glaucoma, and has indicated glaucoma in cases in which five or six months later we were able to see that it was glaucoma." As a matter of fact, a recent review of all the available data at the clinic where the major work was done shows that anterior chamber puncture was done in a total of much less than a hundred cases of all kinds.

If it were true that ". . . three tonometers . . . gave incongruous readings when used on a rubber model" (Kronfeld's first mentioned article, p. 804), all the data gathered, including those on his so-called "normal" group as well as those on all but one of the fifteen eyes in table 3 of his article, should be discarded as they were obtained when the tonometers were supposedly not acting properly.

In December, 1930, Kronfeld presented a paper on this subject before the New York Academy of Medicine. This paper was never published. Could it be that my work, which Kronfeld was beginning to be conscious of, was acting as a restraining and modifying influence?

It may have been carelessness which permitted his statement concerning case 6 of his German article (The Intra-Ocular Tension Following

Anterior Chamber Puncture in Glaucoma, *Ztschr. f. Augenh.* **71**: 64, 1930), that two years had elapsed since the last puncture was done. At that time the patient had been under observation a total of less than eight months.

It seems desirable, too, to make clear that the data concerning several of the fifteen eyes cited in his table 3 had previously been presented by him in his German article, although he apparently fails to mention this repetition of data.

To bring this answer to a close I can say only that there is no single serious criticism in Kronfeld's entire article which can be justified by the undisguised presentation of all essential facts. While there may be an increased irritability of the vascular bed of the eye in glaucoma, this vascular instability does not seem to be limited to cases of glaucoma. I can only repeat again that there is little dependable evidence to indicate that the increase in tension after anterior chamber puncture is sufficiently large or appears with sufficiently greater rapidity in certain eyes than in others to justify the use of this method as a test for glaucoma.

SAMUEL V. ABRAHAM, M.D., Los Angeles.

Book Reviews

Oculo-Sympathetic Syndromes. By E. Morelli. Price, 40 lire. Pp. 461. Pisa: Giardini, 1933.

Following a brief history of the knowledge of the sympathetic nervous system, the anatomy is reviewed, including the sympathetic connections of the spinal cord and the cranial nerves.

The second part of the book considers the functions of the neurovegetative system in general and its relation to the eye. Dilatation of the pupil accompanying pain in the pleura or abdomen is considered a type of neurovegetative reflex, as distinct from pupillary changes due to direct pressure or irritation of the cervical sympathetic. While there is no evidence that "trophic nerves" exist, there can be no doubt that the neurovegetative system exerts a control on local metabolism, and that when this is removed, as by section of the fifth nerve, various disturbances described as "trophic" occur.

The experimental and clinical results of cervical sympathectomy are reviewed. The vasomotor phenomena described, such as dilatation of the retinal vessels, are brief and inconstant. Stimulation of the sympathetic system increases the amount of albumin in the aqueous, apparently by increasing capillary permeability. Such changes in the composition of the aqueous may produce changes in intra-ocular tension, and the effect of trauma to the eye may be explained in this manner. The increase of tension in the opposite eye following trauma is apparently due to reflex irritation of the parasympathetic apparatus.

Part III is devoted to the diagnosis of disorders of the neurovegetative system. The various reflexes used in estimating predominance of the vagus or sympathetic systems are described in detail, including the oculocardiac reflex as elicited by several methods. The pharmacodynamic tests are analyzed, the author having tested a number of drugs used for this purpose. Instillation of atropine produces a slight but inconstant conjunctival congestion. Two per cent pilocarpine produces a more marked vasodilatation, whereas 3 per cent physostigmine (eserine) causes definite vasoconstriction. The effects of epinephrine, cocaine, amyl nitrite, acetylcholine, quinine, histamine and pituitary were also studied. Examination of the capillary system by capillary microscopy and Scheerer's method of auto-endoscopy are considered of value in determining disturbances of circulatory equilibrium.

Part IV considers oculosympathetic syndromes, to which the preceding parts are introductory. Ocular angiospasm is considered one of the most important of these conditions, depending on disturbances of neurovegetative equilibrium. The vast literature on this subject is reviewed. The author believes that the retinal circulation cannot be totally suspended for more than thirty minutes without causing permanent and grave destruction of the retina. He thinks that reports of much longer periods followed by recovery must be explained as either incomplete closure or intermittent closure, enough blood reaching the retina during the intervals to maintain nutrition.

The relations between glaucoma and the neurovegetative system are discussed at length, with the conclusion that "glaucoma develops in persons with imbalance of the neurovegetative system and in whom there occurs an exaggerated reaction of the vascular system to stimuli not always recognizable. It belongs to the group of vegetative reflex syndromes." Morelli explains on this basis the effects of the drugs used in glaucoma such as physostigmine, pilocarpine and ergotamine, most of which (with the exception of epinephrine) stimulate the parasympathetic system, the sympathetic being usually dominant in glaucoma. There are, of course, many points which are open to argument.

In exophthalmic goiter a neurovegetative instability seems to be present, and the exophthalmos is probably best explained as due to angiospasm of the orbital vessels resulting in increased capillary permeability and accumulation of fluid in the orbit. The author believes that the smooth muscles of the orbit, especially Landstrom's muscle, may also play a part in producing vascular stasis.

Interesting experimental work on the relation of the eye to endocrine glands is reviewed, but, as might be expected, the reports are sometimes conflicting. It is difficult to follow the author's reasoning which leads him to include keratomalacia and sympathetic ophthalmia in this group of syndromes. On the whole, in this clinical portion of the book a good deal of the evidence quoted seems to be of little scientific value, and there is a tendency, in conditions of doubtful pathogenesis, to make the neurovegetative system responsible.

SANFORD R. GIFFORD.

News and Notes

EDITED BY DR. JOHN HERBERT WAITE

GENERAL NEWS

American Optical Company Celebrates Hundredth Anniversary.—In Southbridge, Mass., on September 6, the American Optical Company celebrated the one hundredth anniversary of its founding. It was announced that the late George W. Wells had provided $100,000 to establish a foundation to perpetuate the memory of the founder of the company. This fund has already more than doubled, and provision has been made to expand it to half a million dollars. Eventually, the income from the fund will be used for worthy causes.

Directory of Ophthalmologic Societies *

INTERNATIONAL

International Association for Prevention of Blindness

President: Prof. F. de Lapersonne, 217, Faubourg St. Honoré, Paris.
Secretary-General pro tem.: Dr. A. Churchill, 66 Boulevard St. Michel, Paris.

International Ophthalmologic Congress

Secretary: Dr. Francisco Poyales, Olozaga 3, Madrid.

FOREIGN

British Medical Association, Section on Ophthalmology

President: Dr. Frank H. Crawley, 5 Fitzwilliam Pl., Dublin.

Ophthalmological Society of Bombay

President: Dr. D. D. Sathaye, 127 Girgaum Road, Bombay 4.
Secretary: Dr. H. D. Dastur, Dadar, Bombay, 14.
Place: H. B. A. Free Ophthalmic Hospital, Parel, Bombay 12. Time: First Friday of every month.

Ophthalmological Society of the United Kingdom

President: Mr. A. H. H. Sinclair, 6 Charlotte Square, Edinburgh.
Secretary: Mr. Humphrey Neame, 56 Portland Place, London, W. I.

Oxford Ophthalmological Congress

Master: Dr. Cyril Walker, Bristol, England.
Secretary: Dr. C. G. Russ Wood, Hill House, Abberbury Rd., Iffley, Oxford, England.

Royal Society of Medicine, Section of Ophthalmology

President: Dr. A. C. Hudson, 50, Queen Anne St., W. 1, London.
Secretary: Dr. J. D. Magor Cardell, 27, Weymouth St., W. 1, London.

Société Française d'Ophthalmologie

Secretary: Dr. René Onfray, 6 avenue de la Motte Picquet, Paris 7è.

German Ophthalmological Society

Secretary: Prof. A. Wagenmann, Heidelberg.
Time: 1934.

NATIONAL

American Medical Association, Section on Ophthalmology

Chairman: Dr. William C. Finnoff, 1612 Tremont St., Denver.
Secretary: Dr. Parker Heath, 1551 Woodward Ave., Detroit.
Place: Cleveland. Time: June 11-15, 1934.

* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

American Academy of Ophthalmology and Oto-Laryngology

President: Dr. B. R. Shurley, 62 W. Adams Ave., Detroit.
President-Elect: Dr. J. M. Wheeler, 30 W. 59th St., New York.
Executive Secretary-Treasurer: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.

American Ophthalmological Society

President: Dr. W. G. M. Byers, 1458 Mountain St., Montreal.
Secretary-Treasurer: Dr. J. Milton Griscom, 2213 Walnut St., Philadelphia.
Place: Lucerne, Que. Time: July 9-11, 1934.

SECTIONAL

New England Ophthalmological Society

President: Dr. Hugo B. C. Riemer, 128 Newbury St., Boston.
Secretary-Treasurer: Dr. Benjamin Sachs, 483 Beacon St., Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

Pacific Coast Oto-Ophthalmological Society

President: Dr. A. W. Morse, 66 W. Park St., Butte, Montana.
Secretary-Treasurer: Dr. Frederick C. Cordes, 384 Post St., San Francisco.

Puget Sound Academy of Ophthalmology and Oto-Laryngology

President: Dr. H. R. Secoy, 1802 Hewitt Ave., Everett, Wash.
Secretary-Treasurer: Dr. Francis A. Brugman, 806 Cobb Bldg., Seattle.
Time: 8 p. m., third Tuesday of each month, except July and August.

Saginaw Valley Academy of Ophthalmology and Otolaryngology

President, Dr. A. R. McKinney, 703 Second National Bank Bldg., Saginaw, Mich.
Secretary-Treasurer: Dr. W. K. Slack, 308 Eddy Bldg., Saginaw, Mich.
Place: Saginaw, Mich., or Bay City, Mich. Time: First Friday of each month, except July and August.

Sioux Valley Eye and Ear Academy

President: Dr. John B. Gregg, 101 S. Main St., Sioux Falls, S. Dakota.
Secretary-Treasurer: Dr. F. H. Roost, 420 Trimble Bldg., Sioux City, Iowa.

Southern Medical Association, Section on Eye, Ear, Nose and Throat

Chairman: Dr. William D. Gill, 323 Medical Arts Bldg., San Antonio, Texas.
Secretary: Dr. William A. Wagner, 200 Carondelet St., New Orleans.
Place: Richmond, Va. Time: November, 1933.

Southwestern Michigan Triological Society

President: Dr. Carl Snapp, 604 Medical Arts Bldg., Grand Rapids.
Secretary-Treasurer: Dr. Lee O. Grant, 420 Medical Arts Bldg., Grand Rapids.
Time: Third Thursday of alternate months.

STATE

Colorado Ophthalmological Society

President: A presiding officer is selected for each meeting alternately until all members have served.
Secretary: Dr. Edna M. Reynolds, 920 Republic Bldg., Denver.
Place: Capitol Life Building, Denver. Time: 7:30 p. m., third Saturday of the month, October to April, inclusive.

Connecticut State Medical Society, Section on Eye, Ear, Nose and Throat

President: Dr. Edward J. Whalen, 750 Main St., Hartford.
Secretary-Treasurer: Dr. Walter L. Hogan, 750 Main St., Hartford.
Time: May, November.

Eye, Ear, Nose and Throat Club of Georgia

President: Dr. W. R. Bedingfield, 753 Broad St., Augusta.
Secretary-Treasurer: Dr. J. A. Smith, 700 Spring St., Macon.
Place: Augusta. Time: May, 1934.

Indiana Academy of Ophthalmology and Oto-Laryngology

President: Dr. Robert J. Masters, 805 Hume-Mansur Bldg., Indianapolis.
Secretary: Dr. J. Kent Leasure, 23 E. Ohio St., Indianapolis.
Place: Indianapolis. Time: Dec. 13, 1933.

Iowa Academy of Ophthalmology and Oto-Laryngology

President: Dr. W. W. Pearson, 410 Sixth Ave., Des Moines.
Secretary-Treasurer: Dr. W. F. Boiler, 105 E. Iowa Ave., Iowa City.

Michigan State Medical Society, Section of Ophthalmology and Otolaryngology

Chairman: Dr. Ray Connor, 28 W. Adams Ave., Detroit.
Secretary: Dr. Ralph B. Fast, 136 E. Michigan Ave., Kalamazoo.

Minnesota Academy of Ophthalmology and Oto-Laryngology

President: Gordon B. New, Mayo Clinic, Rochester.
Secretary-Treasurer: Dr. Walter E. Camp, Medical Arts Bldg., Minneapolis.
Time: Second Friday of each month from October to May.

Montana Academy of Oto-Ophthalmology

President: Dr. Lawrence G. Dunlap, 101 Main St., Anaconda.
Secretary: Dr. A. W. Morse, Phoenix Bldg., Butte.

New Jersey State Medical Society, Section on Ophthalmology, Otology and Rhinolaryngology

Chairman: Dr. S. T. Hubbard, 294 State St., Hackensack.
Secretary: Dr. G. S. Laird, 125 Central Ave., Westfield.
Place: Atlantic City. Time: June, 1934.

New York State Medical Society, Eye, Ear, Nose and Throat Section

Chairman: Dr. D. F. Gillette, 109 S. Warren St., Syracuse.
Secretary: Dr. Frank M. Sulzman, 1831 Fifth Ave., Troy.

North Dakota Academy of Ophthalmology and Oto-Laryngology

President: Dr. H. O. Ruud, 318 De Mers Ave., Grand Forks.
Secretary-Treasurer: Dr. F. L. Wicks, 516 Fourth St., Valley City.
Place: Valley City. Time: 1934.

Oregon Academy of Ophthalmology and Oto-Laryngology

President: Dr. A. B. Dykman, Medical Dental Bldg., Portland.
Secretary-Treasurer: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

Rhode Island Ophthalmological and Otological Society

President: Dr. Robert C. O'Neil, 105 Waterman St., Providence.
Secretary: Dr. Gordon J. McCurdy, 122 Waterman St., Providence.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Walter Bristow, Medical Bldg., Columbia.
Secretary: Dr. J. W. Jervey, Jr., 101 Church St., Greenville.
Place: Columbia. Time: October, 1933.

TENNESSEE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. C. D. Blassingame, 899 Madison Ave., Memphis.
Secretary-Treasurer: Dr. Ralph O. Rychener, 130 Madison Ave., Memphis.

TEXAS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. O. S. Hodges, 388 Pearl St., Beaumont.
Secretary: Dr. A. F. Clark, 1034 Nix Professional Bldg., San Antonio.

UTAH OPHTHALMOLOGICAL SOCIETY

President: Dr. W. T. Hasler, 290 W. Center St., Provo.
Secretary-Treasurer: Dr. T. F. Welsh, 920 Boston Bldg., Salt Lake City.
Time: Third Monday of each month.

VIRGINIA SOCIETY OF OTO-LARYNGOLOGY AND OPHTHALMOLOGY

President: Dr. H. G. Preston, 307 Professional Bldg., Harrisonburg.
Secretary: Dr. Edwin W. Burton, 104 E. Market St., Charlottesville.

WEST VIRGINIA STATE MEDICAL ASSOCIATION, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. Harry V. Thomas, 95 Fairmont Ave., Fairmont.
Secretary: Dr. W. F. Beckner, 1050 5th Ave., Huntington.

LOCAL

ACADEMY OF MEDICINE OF NORTHERN NEW JERSEY, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. Elbert A. Curtis, 65 Central St., Newark.
Secretary: Dr. A. Russell Sherman, 671 Broad St., Newark.
Place: 91 Lincoln Park South. Time: 8:45 p. m., second Monday of each month.

ACADEMY OF MEDICINE OF TORONTO, SECTION OF OPHTHALMOLOGY

Chairman: Dr. Colin Campbell, 170 St. George St., Toronto.
Secretary: Dr. H. M. Macrae, 170 St. George St., Toronto.
Time: First Monday of winter months.

ATLANTA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. G. E. Clay, 384 Peachtree St., N. E., Atlanta, Ga.
Secretary: Dr. William O. Martin, Jr., Medical Arts Bldg., Atlanta, Ga.
Place: Academy of Medicine, 38 Prescott St., N. E. Time: 8 p. m., last Thursday of each month.

BALTIMORE MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Benjamin Rones, Johns Hopkins Hospital, Baltimore.
Secretary: Dr. William M. Rowland, 906 Cathedral St., Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to May.

BROOKLYN OPHTHALMOLOGICAL SOCIETY

President: Dr. W. F. C. Steinbugler, 515 Ocean Ave., Brooklyn.
Secretary: Dr. Walter V. Moore, 1 Nevins St., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday in February, April, May, October and December.

Buffalo Ophthalmologic Club

President: Dr. H. H. Glosser, 448 Franklin St., Buffalo.
Secretary-Treasurer: Dr. I. J. Koenig, 40 North St., Buffalo.

Chicago Ophthalmological Society

President: Dr. Dwight C. Orcutt, 30 N. Michigan Ave., Chicago.
Secretary: Dr. Richard C. Gamble, 30 N. Michigan Ave., Chicago.
Place: Medinah Michigan Avenue Club, 505 N. Michigan Ave. Time: Third Monday of each month from October to May.

Cleveland Academy of Medicine, Section of Ophthalmology and Oto-Laryngology

Chairman: Dr. Justin M. Waugh, Cleveland Clinic, Cleveland.
Secretary: Dr. James T. Collins, 1105 Medical Arts Bldg., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

Cleveland Ophthalmological Club

Chairman: Dr. W. P. Chamberlain, 7405 Detroit Ave., Cleveland.
Secretary: Dr. A. D. Ruedemann, Cleveland Clinic, Cleveland.

College of Physicians, Philadelphia, Section on Ophthalmology

Chairman: Dr. L. F. Appleman, 308 S. Sixteenth St., Philadelphia.
Clerk: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

Columbus Ophthalmological and Oto-Laryngological Society

Chairman: Dr. Albert D. Frost, 681 E. Broad St., Columbus, Ohio.
Secretary-Treasurer: Dr. M. Goldberg, 328 E. State St., Columbus, Ohio.
Time: First Monday of each month.

Dallas Academy of Ophthalmology and Oto-Laryngology

President: Dr. T. S. Love, 1719 Pacific Ave., Dallas, Texas.
Secretary: Dr. Daniel Brannin, 1719 Pacific Ave., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6:30 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Des Moines Academy of Ophthalmology and Otolaryngology

President: Dr. Cecil C. Jones, 1121 Equitable Bldg., Des Moines, Iowa.
Secretary-Treasurer: Dr. Grace Doane, 614 Bankers Trust Bldg., Des Moines, Iowa.
Time: 7:45 p. m., third Monday of every month, September to May.

Detroit Ophthalmological Club

Chairman: Members rotate alphabetically.
Secretary: Dr. Raymond S. Goux, David Whitney Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month.

Eastern New York Eye, Ear, Nose and Throat Association

President, Dr. Edward B. O'Keefe, 901 State St., Schenectady.
Secretary-Treasurer: Dr. W. C. Mott, 118 Washington Ave., Albany.
Time: Third Wednesday in October, November, March, April, May and June.

Fort Worth Eye, Ear, Nose and Throat Society

President: Dr. Valin R. Woodward, Flatiron Bldg., Forth Worth, Texas.
Secretary-Treasurer: Dr. Van D. Rathgeber, 1012 Medical Arts Bldg., Fort Worth.
Place: Medical Hall, Medical Arts Bldg. Time: 7:30 p. m., first Friday of each month except July and August.

Grand Rapids Eye, Ear, Nose and Throat Society

President: Dr. Carl F. Snapp, 26 Sheldon Ave., Grand Rapids, Mich.
Secretary-Treasurer: Dr. Walter W. Oliver, 320 Medical Arts Bldg., Grand Rapids, Mich.
Place: Various local hospitals. Time: Third Thursday of alternating months, September to May.

Houston Academy of Medicine, Eye, Ear, Nose and Throat Section

President: Dr. J. F. Gamble, 201 Main St., Houston, Texas.
Secretary: Dr. B. F. Payne, 1304 Walker Ave., Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., second Thursday of each month from September to June.

Indianapolis Ophthalmological and Oto-Laryngological Society

President: Dr. D. A. Bartley, 23 E. Ohio St., Indianapolis.
Secretary: Dr. Kenneth L. Craft, 23 E. Ohio St., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

Kansas City Society of Ophthalmology and Oto-Laryngology

President: Dr. M. B. Simpson, 1103 Grand Ave., Kansas City, Mo.
Secretary: Dr. Harold B. Hedrick, 618 Professional Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

Long Beach Eye, Ear, Nose and Throat Society

Chairman: Dr. Clifford S. Losey, 219 E. 10th St., Long Beach, Calif.
Secretary-Treasurer: Dr. Kenneth C. Brandenburg, 707 Security Bldg., Long Beach, Calif.
Place: Professional Bldg. Time: Last Wednesday of each month from October to May.

Los Angeles Society of Ophthalmology and Oto-Laryngology

President: Dr. D. E. Godwin, 910 Security Bldg., Long Beach, Calif.
Secretary-Treasurer: Dr. F. H. Brandt, 1052 W. Sixth St., Los Angeles.
Place: Los Angeles County Medical Association, 1925 Wilshire Blvd. Time: 6:30 p. m., fourth Monday of each month from September to May, inclusive.

Louisville Eye, Ear, Nose and Throat Society

President: Dr. Karl N. Victor, Breslin Bldg., Louisville, Ky.
Secretary-Treasurer: Dr. J. S. Bumgardner, Heyburn Bldg., Louisville, Ky.
Place: French Village. Time: Second Thursday of each month, September to May, inclusive, at 6:30 p. m.

Medical Society of the District of Columbia, Section of Ophthalmology and Oto-Laryngology

Chairman: Dr. George B. Trible, 1801 I St., Washington.
Secretary: Dr. Harry F. Davies, 1835 I St., Washington.
Place: 1718 M St., N. W. Time: 8 p. m., third Friday of each month from October to April, inclusive.

Memphis Society of Ophthalmology and Otolaryngology

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, Exchange Bldg., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

Milwaukee Oto-Ophthalmic Society

President: Dr. Samuel G. Higgins, 324 E. Wisconsin Ave., Milwaukee.
Secretary-Treasurer: Dr. O. P. Schoofs, 324 E. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6:30 p. m., third Tuesday of each month.

Montreal Ophthalmological Society

President: Dr. J. P. E. Bousquet, 66 Sherbrooke St., West, Montreal, Canada.
Secretary: Dr. J. A. MacMillan, 1410 Stanley St., Montreal, Canada.
Time: Second Thursday of October, December, February and April.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. Eugene Orr, 706 Church St., Nashville, Tenn.
Secretary-Treasurer: Dr. H. C. Smith, Medical Arts Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month from October to June.

New Orleans Ophthalmological and Otolaryngological Society

President: Dr. M. F. Meyer, Canal Bank Bldg., New Orleans.
Secretary-Treasurer: Dr. R. H. Fisher, Chess and Checker Club, New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: Third Thursday of each month from October to June.

New York Academy of Medicine, Section of Ophthalmology

Chairman: Dr. Webb William Weeks, 20 E. 53rd St., New York.
Secretary: Dr. Guernsey Frey, 121 E. 60th St., New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

Omaha and Council Bluffs Ophthalmological and Oto-Laryngological Society

President: Dr. L. G. Howard, 532 First Ave., Council Bluffs, Iowa.
Secretary-Treasurer: Dr. W. A. Cassidy, 1620 Medical Arts Bldg., Omaha.
Place: Omaha Club, 20th and Douglas Sts., Omaha. Time: 6 p. m., dinner; 7 p. m., program; third Wednesday of each month from October to May.

Pittsburgh Ophthalmological Society

President: Dr. Edward B. Heckel, Jenkins Arcade Bldg., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

Pittsburgh Slit-Lamp Society

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: 121 University Pl. Time: Second Monday evening of every month, except June, July, August and September.

Richmond Ophthalmological and Oto-Laryngological Society

President: Dr. R. W. Vaughan, Medical Arts Bldg., Richmond, Va.
Secretary: Dr. William R. Weisiger, Medical Arts Bldg., Richmond, Va.
Place: Westmoreland Club. Time: 6 p. m., second Monday of each month from October to May.

Rochester Eye, Ear, Nose and Throat Society

Chairman: Dr. W. E. Munroe, 277 Alexander St., Rochester, N. Y.
Secretary-Treasurer: Dr. E. W. O'Brien, 5 N. Goodman St., Rochester, N. Y.
Place: Rochester Medical Association, 113 Prince St. Time: 8 p. m., third Monday of each month from October to May.

St. Louis Ophthalmic Society

President: Dr. Max W. Jacobs, Missouri Theatre Bldg., St. Louis.
Secretary: Dr. Carl T. Eber, 1006 Carleton Bldg., St. Louis.
Place: Oscar Johnson Institute. Time: Clinical meeting 5:30 p. m., dinner and scientific meeting 6:30 p. m., fourth Friday of each month from October to April, inclusive, except December.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. Robert E. Parrish, 712 Medical Arts Bldg., San Antonio, Texas.
Secretary-Treasurer: Dr. E. King Gill, 323 Medical Arts Bldg., San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

San Francisco County Medical Society, Section on Eye, Ear, Nose and Throat

Chairman: Dr. George N. Hosford, 490 Post St., San Francisco.
Secretary: Dr. Russell Fletcher, 490 Post St., San Francisco.
Place: Society's Building, 2180 Washington St., San Francisco.
Time: Fourth Tuesday of every month except May, June, July and December

Shreveport Eye, Ear, Nose and Throat Society

President: Dr. T. D. Boaz, Medical Arts Bldg., Shreveport, La.
Secretary-Treasurer: Dr. W. L. Atkins, 940 Margaret Pl., Shreveport, La.
Place: 1240 Texas Ave. Time: 7:30 p. m., first Monday of each month from October to June.

Spokane Academy of Ophthalmology and Oto-Laryngology

President: Dr. C. A. Veasey, Jr., 407 Riverside Ave., Spokane, Wash.
Secretary: Dr. J. L. Walter, Paulsen Medical and Dental Bldg., Spokane, Wash.
Place: Paulsen Medical and Dental Library. Time: 8 p. m., fourth Tuesday of each month except June, July and August.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. H. O. Brust, 820 S. Crouse Ave., Syracuse, N. Y.
Secretary-Treasurer: Dr. W. J. Werfelmann, 109 S. Warren St., Syracuse, N. Y.
Place: University Club. Time: Second Friday of each month except June, July and August.

Tulsa Academy of Ophthalmology and Otolaryngology

President: Dr. Roy Dunlap, Medical Arts Bldg., Tulsa, Okla.
Secretary-Treasurer: Dr. Marvin D. Henley, Medical Arts Bldg., Tulsa, Okla.
Place: Medical Arts Bldg. Time: Monthly.